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THE BASIS OF IMMUNITY.[1]

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WITH the possible exception of certain cases of food poisoning, in which the harmful agent is produced by the activities of organisms in the food, the production of bacterial disease is conditioned by the invasion of the tissues by organisms and their multiplication therein. The problem of the mechanism of immunity is, then, the problem of determining the nature of the barriers to invasion, the factors influencing the growth of the organisms after invasion and the method of neutralizing their products.

[1] Read at the second annual reunion of the Residents' and Ex-Residents' Association, Royal Prince Alfred Hospital, Sydney, October, 1931.

The general importance of the covering and lining membranes of the cavities of the body, of the skin and mucous membranes has long been appreciated. It is clear that the skin is a very effective barrier against the invasion of the body by all but a very small group of organisms. Koch early appreciated the importance of the acidity of the gastric secretion in the prevention of the experimental production of cholera in laboratory animals. But the exact mechanism of this line of defence and, indeed, the mechanism of the invasion of the body by way of the mucous surfaces, still remain little investigated. Arnold has shown how the reaction of the intestinal contents influences the distribution of bacteria within the gut and how this may be modified by factors in the environment, such as temperature and moisture. Similarly on the skin the persistence of pathogenic organisms is usually short, unless they are protected against the self-disinfecting

action of the skin, which again is influenced greatly by the reaction. Clinically, it has long been maintained that resistance to disease is greatly or significantly lowered by a variety of non-specific factors, such as exposure to cold, exhaustion, starvation and defective diets. The experimental evidence on these points is not large in amount, but the work of Boycott and Price Jones is interesting in that it shows that while fatigue, as Spaeth showed, has little effect on an infection of rats produced by parenteral inoculation, it may influence very considerably the course of one produced by the same type of organism administered by a natural channel, the alimentary tract. In both the normal and the fatigued animals some invasion of the body occurred, but only in the latter did disease develop.

As regards diet, there is now a great deal of evidence, both clinical and experimental, that a deficiency of certain accessory substances, particularly vitamin *A*, is conducive to infection, both in experimental epidemics and in natural infection (Mellanby and Green). It also makes possible the infection of animals with organisms that are not ordinarily pathogenic for them, as Findlay has shown. But what underlies these changes is by no means clear. Antibody production is apparently uninfluenced and phagocytosis is as active as usual. In certain of the animals on deficient diets changes in the mucous membranes are well marked, either as atrophies or as hyperplasias. Mellanby's work would suggest that invasion of the body is commoner in such animals, and it is possible that the changed membranes simply provide foci in which multiplication of the organisms is easier. Other possible factors are modification of the physiology of the animal, as, for example, alteration of temperature to one which is more favourable to the growth of the bacteria. Mellanby has also suggested that addition of vitamins to the diet has a deterrent effect on the course of puerperal infections, and others have advocated the use of ultra-violet light to combat infection. The recent work of Topley and his colleagues shows, however, that an excess of vitamin *A* is without significant effect on the course of an artificial epidemic, and there is abundant recent work to show that the influence of light on general resistance is negligible. Exposure to cold no doubt predisposes to disease, but there is little indication of how this is effected. There is a little evidence that changes are produced reflexly in the mucous membranes of the upper respiratory tract. We know from the work of Bailey that such a simple procedure as washing out the nasal passages with a weak solution of an antiseptic may convert a trivial chronic disorder of rabbits into a fatal disease. Possibly cold may act in the same sort of way and this sort of result is perhaps an indication for a degree of conservatism in the handling of the nasal mucous membranes. Immunity or resistance is a relative term, and these examples will serve to indicate how people or animals, apparently equally well equipped with the humoral defence mechanism, may, as the result of a variety of non-specific contingencies, be very unequally placed in relation to their opposition to infection, and particularly in relation to their first line of defence.

Of recent years much interest has attached to the work of Besredka upon the mechanism of defence against intestinal infections. His view is that immunity does not in any way depend upon the presence of antibodies in the circulating blood, but is due to changes induced locally in the mucous membranes of the gut as a result of which invasion is prevented. As will appear later, there is every reason to doubt these conclusions as to the occurrence of immunity in the absence of antibodies, and recent work of Orskov and a group of collaborators places the matter in quite a different light. This work has been done with a variety of organisms naturally pathogenic for mice, and it has been found that, after oral administration, they pass through the mucous membranes to the nearest lymphoid masses, from which they pass to the nearest lymph glands in the neck or abdomen. Then, *viâ* the lymphatic channels they make their way to the blood stream and are disseminated over the body, localizing secondarily in the liver, spleen and intestine, where they multiply and once more enter the blood and the intestinal contents. Invasion is possible both for virulent and for avirulent organisms in varying degree, the main difference between the two groups being that the avirulent organisms do not become so widely disseminated, but are held up more completely in the lymphoid areas. These experiments do not support Besredka's views, but tend rather to uphold the more orthodox idea that resistance in typhoid fever, as in other diseases, is dependent upon capacity to dispose of organisms that have invaded the tissues. An extension of this work to the study of tuberculosis in the guinea-pig gave similar results and showed that avirulent strains administered by the mouth do not, as has been suggested, enter the blood and spread rapidly over the whole body. *Bacille Calmette-Guérin*, for example, is rapidly localized close to the portal of entry. No difference could be found between young and adult animals in this respect. Moreover, the avirulent strain so administered must apparently be relatively ineffective as an immunizing agent because of its limited opportunities of coming into contact with the antibody producing mechanism owing to its very definite localization, and is indeed, in the intestinal infections with the salmonella organisms, less effective than the ordinary vaccine injected parenterally. There is evidently room for much more work along these lines before Calmette's proposed procedure of immunizing very young infants against tuberculosis by the administration of avirulent strains of tubercle bacilli by the mouth can be said to be really well grounded on experiment.

The essential problem of immunity then comes to be: "What is the mechanism of disposal of organisms which enter the body and, in particular,

of those which enter the circulation?" Originally it was believed that foreign particles were eliminated by way of the kidney and the liver, but Sherrington clearly demonstrated that the organisms injected into the blood did not pass through these organs unless some damage had been done. This classical piece of work is very frequently overlooked by later writers. As far back as 1887 Wyssokowitsch demonstrated the part played by the liver and the spleen in this process. When inert particles of organic or inorganic material are injected into the peripheral circulation, they are very rapidly accumulated in the lung, the liver and the spleen, at first in high concentration in the lung and later migrating to other organs, especially the liver. If the injection is made into the portal circulation, the liver receives the greatest preliminary concentration. Drinker and his assistants have studied this matter in great detail and have attempted to eliminate the effect of physical aggregation of the particles in determining the point of primary localization. No doubt, as they show, the final distribution of the particles is conditioned by the phagocytosis of these by the cells lining the capillaries of the liver and the spleen and by mononuclear cells of different kinds. But in the first instance physical aggregation of the particles in the blood stream plays an important rôle. I have found it practically impossible to protect the submicroscopical particles of India ink with gelatin against the precipitating influence of heparinized blood, that is, blood which still contains its fibrinogen but does not clot, *in vitro*. The action of salt is relatively easy to prevent, as also that of serum, but the more nearly the fluid approaches to the composition of the whole blood, the more marked is its power to aggregate or agglutinate suspensions of this type. And, however we handle blood *in vitro*, we cannot avoid reducing its instability, for all our procedures aim at preventing clotting, so that it seems highly probable that this tendency to produce aggregates will be still more marked *in vivo*. And, indeed, it can be seen very well in the form of the deposits of precipitated ink formed locally after intraperitoneal injections. The mechanism which the animal has at its disposal for the removal or localization of suspensoid substances is that of aggregation and phagocytosis, and the rate of disposal of such substances will depend on the ease with which these activities can be brought into play. There is no evidence that practice improves this mechanism.

Preparations of the kind described are known as suspensoids and are characterized by the ease with which they are precipitated by electrolytes, that is to say, salt solutions. But there is another class of colloidal substances, called emulsoids, which are much less susceptible to such influences. Among these are the proteins, and, in their general behaviour, most pathogenic bacteria resemble the proteins. If a protein is injected into the blood stream of a normal animal, it is removed relatively slowly, and traces of it may be detected for some days, a fact which is well shown in the persistence of antitoxin in the blood after the injection of an antitoxic horse serum into a normal animal.

This fact explains the occurrence of serum sickness after an interval of some days following the serum injection, the serum injected persisting in the body until such time as the antibody content of the cells reaches a level sufficiently high to permit it to react with the serum and determine the group of symptoms recognized as serum sickness.

But in this instance the animal organism learns by practice how to dispose of the material more quickly and, when the serum of such an experienced animal is examined, it is found to have added to its normal armamentarium a new form of unstabilizing effect—the effect which we call precipitation. And so it behaves to all such emulsoids as are antigenic, whether they are of animal or vegetable or bacterial origin, if only they be foreign, that is to say, chemically different. They may be in the form of sols or of cells, they may be living or dead. Provided the experience of the animal has been sufficient, this altered stability can usually be easily demonstrated *in vitro*. If the antigen is organized into a cellular form, we speak of the change as agglutination. And when these aggregates are formed under appropriate conditions they have a marked capacity for the adsorption of a normal constituent of serum known as complement. Sometimes this adsorption leads to the disintegration of the antigen, and we speak of lysis, but more often it produces no obvious visible effect. But by the use of tests devised to show if complement has been removed from the fluid we may determine that interaction has occurred between an antigen and its appropriate antiserum, although the aggregates formed are too small to be visible. In fact, as Dean has long maintained, beneath all these manifestations of serum activity there probably lies one fundamental type of reaction whose simplest expression is that of altered stability or aggregation.

It would take us too far out of our way to discuss in detail the physical basis of the phenomenon of aggregation, but the work of Northrop and his colleagues and of Shibley would seem to indicate that it is a fairly simple matter. Protein dissolved in salt solutions, when heated above a certain temperature, coagulates. But it has been shown that this phenomenon occurs in two stages: first, the heating produces a change in the protein which occurs whether the protein is dissolved in water or in saline solution, and then there is a precipitation of this changed protein by electrolytes. Denaturation is, then, a change from the emulsoid state, relatively insusceptible to the action of salts, to the suspensoid condition, with increased susceptibility to such action. Bordet long ago showed that agglutination of bacteria by specific serum did not occur in the absence of electrolytes, though the antibody combined with the antigen. It has remained for the later workers, especially Shibley, to show that agglutination is closely connected with the denaturation of protein. Bacteria suspended in normal serum appear to adsorb a small amount of protein

from the serum as a coating which retains the properties of the original protein. But when they are placed in a serum which contains specific antibodies, the adsorbed protein layer becomes denatured. In the absence of salts the bacteria so coated with denatured protein remain in suspension, but, if the coating is sufficiently extensive and there is enough salt present, agglutination occurs. Antibody production thus comes to be seen as a mechanism which enables the animal to deal with this special kind of foreign substance in precisely the same sort of way as it is accustomed to deal with ordinary suspensions. So that the rate at which bacteria will be removed from the circulation after injection will depend on two factors, the stability of the bacterial suspension and the presence or absence of antibodies in the blood. Organisms like the streptococci are usually quite unstable in normal saline solution and might therefore be expected to be removed quickly in any animal, as indeed they are; organisms like the typhoid bacillus meet with a certain amount of natural antibody in most animals, and they are as a rule easily removed in consequence. Quite small amounts of antibody would seem to be effective. The most satisfactory results have been obtained from the study of the relatively stable pneumococci in the blood of the rabbit, which is practically devoid of antibodies.

When a culture of pneumococci is injected into the ear vein of a rabbit, the majority of the organisms disappear from the peripheral blood in a very short time. But the rate at which they are removed, the completeness of the removal and the subsequent events depend on the virulence of the strain used, the age of the culture and the degree of immunity possessed by the animal. Using a fully grown culture of virulent pneumococci, one sees a fairly rapid diminution in the number of the circulating organisms, which goes on for a few hours, usually three to five, at a progressively diminishing rate, and is succeeded by a period during which the numbers slowly increase. This increase may be maintained until the death of the animal after twenty-four or forty-eight hours, or else at about the third day a further change in the course of the curve appears in the form of a steady drop in the numbers, slowly progressing to their disappearance from the blood. If we repeat this experiment in the same animal immediately after recovery from the first inoculation, say, about the sixth or seventh day, the curve is quite different. The primary drop is sharper and the disappearance of the bacteria from the blood is complete in a few minutes or hours, and there is no subsequent reappearance. If, however, we employ a non-virulent strain in a normal rabbit, the course of events is similar to what is seen with a virulent strain in an immunized animal. The suggestion of all such work is that immunization does not lead to the production of any new mechanism, but merely extends and elaborates something which already exists. For the removal of bacteria from the blood stream there is a clearing mechanism present in the normal animal in a larval or immature form, which is enhanced by immunization, whether this is induced by infection or by the inoculation of killed cultures. This is shown by the increased speed of removal of the bacteria in some cases and in all by an absence of the return of the bacteria after they have once been removed.

The course of events may be modified in yet another way. Suppose the injection to be made with a culture of virulent pneumococci some six or eight hours after inoculation of the broth. It will then be found that the first part of the curve, the phase of clearing, will be suppressed or considerably curtailed. This is due to the fact that under these circumstances the bacteria constituting the bulk of such a young culture are in a state of active multiplication, while those in an older culture are in a state of suspended activity. When the latter are put into a fresh medium they do not begin to multiply for some time, whereas the younger organisms begin to do so at once if the medium is suitable. With these young bacteria the rate at which they disappear from the blood after inoculation into an animal is a balance between the rate of removal and the rate of formation of new organisms. With an older culture the organisms are being cleared out of the blood, but they do not begin to multiply for some time, until, in short, they have become adapted to the new medium, the animal's blood. But at a certain point of time they do begin to multiply and then the rate of removal slows up or ceases and the phase of increase begins. And it is important to note that this multiplication may not be occurring in the peripheral circulation at all. If we understand properly this second part of our curve, we shall probably approach to an understanding of the nature of what is called septicæmia. The rise in numbers during this period is not due to the fact that the animal has exhausted its clearing mechanism, for a fresh injection is dealt with at this time just as effectively as the original inoculum, and at some points even more so. Nor is there any good evidence that the organisms are resistant to the clearing mechanism during this period, for the organisms in the blood of an infected animal, when injected into a fresh animal without intervening cultivation, are apparently disposed of at once. The meaning of the phase of increase is, I think, simply that by the time that it occurs, niduses have been established at different points which are favourable to multiplication of the bacteria, and from these an overflow takes place and the number of the bacteria in the blood also increases. Hopkins and Parker, in their experiments, quantitatively determined the distribution of hæmolytic streptococci in the various parts of the body after injections into the blood stream of (i) susceptible normal rabbits, (ii) immunized rabbits, and (iii) naturally resistant cats. The bacteria in the naturally resistant and the artificially immunized animals were practically confined to the liver, lungs and spleen. But in the susceptible animals there were large numbers in the muscles,

and it was concluded that these had established foci from which the later entry into the blood occurred. This view receives strong support from Downie's recent microscopical demonstration of multiple minute foci of infection in the muscles in the established streptococcal septicæmia of rabbits. The distribution, then, of bacteria in immune animals is like that of inert particles, but in the less resistant animals the disposal of them is less efficient and facilities are thus provided for their multiplication which may lead to a rapidly fatal septicæmia, or in less severe cases to a local condition, such as peritonitis or arthritis. In some cases a definite improvement begins about the third day or so. In these cases the defensive mechanism is being improved and may become sufficient to clear out the foci and so stop the blood invasion. But even in these cases we have evidence, as in the natural disease of mice known as "mouse typhoid", and in similar conditions in rats, that organisms may persist in such foci for a very long time. These are what Almroth Wright called ecphylactic foci, which may constitute an actual disease or merely a potential danger, such as the carrier condition as we know it in diphtheria or in typhoid fever.

What, then, is the mechanism which rids the blood of its invaders? It is commonly taught and believed that antibodies are only slowly produced and are present in the blood for only a short time, especially in response to injections of pneumococci and similar organisms. It was found that a single intravenous injection of pneumococci into rabbits was followed by a marked enhancement of their clearing capacity. This improvement was quite evident by the third day after injection and, indeed, there was some evidence of it as early as twenty-four or forty-eight hours after. It was also found that in some animals this benefit lasted as long as twelve months after inoculation of a vaccine. These findings were not in accord with the general experience that antibodies to the pneumococcus are difficult to produce and, moreover, it was not possible to demonstrate the ordinary antibodies in the serum of many of the animals which yet were immune. Singer and Adler, on the basis of similar results, have concluded that the immunity against certain pneumococci is a purely cellular phenomenon and is not mediated by antibodies. The same sort of difficulty has been experienced in explaining the natural resistance of certain animals to pneumococci and the changes leading to the crisis in lobar pneumonia. It was on the basis of similar observations that Besredka concluded that immunity in typhoid fever was a local phenomenon in the intestinal wall. Further work has demonstrated that such conclusions depended, not upon the absence of antibodies, but upon the inadequacy of our methods of demonstrating them. Armstrong showed that as early as the third day after injection the serum of a rabbit was able to confer passive immunity on mice and that it continued to do so for many days thereafter. My own experiments showed that the blood of such animals could influence the growth of pneumococci *in vitro* during the same periods, and this was apparently a sort of agglutination such as had been described earlier by Cole. With highly immunized animals it is easy to demonstrate that the whole blood can destroy virulent pneumococci and that this is a combined action of serum and cells resulting in phagocytosis. I was not able to demonstrate this with the blood of the less heavily immunized animals in the very early or the very late stages of immunization. But this defect has been made good by Robertson and his pupils, using a more delicate technique, which has enabled them to demonstrate that where there is immunity to pneumococci, natural or acquired, there also are antibodies directed towards phagocytosis.

This work of Robertson has also been of interest in another connexion. The part played by complement in the phenomena of bacteriolysis and hæmolysis has been long appreciated. It has also been long known that the natural opsonins are greatly helped by the presence of complement, but it has usually been considered that the tropins or immune opsonins need no such adjuvant. Robertson has, however, shown that the destruction of pneumococci by the combined action of immune serum and cells, which is a phagocytic action, is greatly enhanced by the presence of complement. Normal serum may be able to agglutinate staphylococci if the complement is removed. I have found that this agglutination tends to occur more quickly in the unheated serum and still more in plasma. As with inert particles, so also with bacteria, the action of the fluid constituents of the blood tends to be the more marked the more closely they approximate to the nature of whole blood, or, in other words, these processes will tend to occur more readily in the animal body than they do in the test tube. I have tried to measure this difference in a few instances and have found that the number of organisms destroyed by each cubic centimetre of blood *in vitro* is a very poor indication of the capacity of the animal to rid its blood of organisms when these are injected direct into the circulation.

The results of tests *in vitro*, then, are an indication of what may happen in the body, but may be quantitatively much less.

Changes in the serum of immunized animals which in their extreme forms lead to the aggregation of bacteria, and in less marked cases lead to complement fixation, in still less developed phases may show varying degrees of opsonic activity. The animal which has learned to deal with emulsoid substances by aggregating them as it does suspensoids, has at the same time learned also to dispose of them by phagocytosis, as also it finally disposes of the suspensoids, and by using fundamentally the same mechanism, a surface alteration leading to adhesion. The particles or bacteria adhere to one another or they adhere to other surfaces, as the surfaces of fixed or movable cells—altogether a remarkable example of economy of effort. Let us now see what are the details of the disposal of

bacteria within the body. This can best be seen if one examines sections and films taken from the organs of immune animals within a few minutes of the injection of large doses of bacteria. Films of the peripheral blood show little or nothing except a notable diminution in the number of the circulating leucocytes. This has been shown by Andrewes to be due to a congregation of the leucocytes within the capillaries of the internal organs, particularly of the lungs. It is followed later by a leucocytosis, apparently the result of a stimulation of the marrow. There is little or no difference in the response of normal and that of immune animals in this respect. Moreover, if films are made from the blood as it flows away from the cut surface of an organ, very few bacteria are seen. It is only when one squeezes out the last traces of blood from such an organ that one sees them in any numbers. This is, I think, to be interpreted as indicating that the bacteria are, as it were, imprisoned in the capillaries. Within so short a time as five minutes one finds that the majority of the bacteria are no longer seen as isolated individuals. The greater part are seen to be phagocyted and the others are in aggregates, either alone or in conjunction with platelets. Like the inert particles, most are seen in the lung, the liver and the spleen, just where the leucocytes are to be found. Whether the accumulation of leucocytes conditions that of the bacteria or the reverse is not known, but the cells are also found to accumulate in the same way after an injection of protein into an anaphylactic dog, as shown by Dean and Webb, so that the presence of bacteria is not at all necessary. One can easily see the advantage of the simultaneous accumulation of the cells and the bacteria in the same capillary beds, where, incidentally, the rate of movement of the blood probably more nearly approaches that which Robertson and his associates have shown to be optimum for phagocytosis than what is observed in the peripheral stream.

In these preparations one can easily see that both polymorphonuclear and mononuclear leucocytes and fixed cells lining the capillary vessels of certain organs share in the phagocytosis. I have never been able to satisfy myself that the lining cells of the capillaries of the lung play any part at all, but in the liver the so-called Kupffer cells are always seen to be very active. In the earlier work on phagocytosis of bacteria the predominant rôle was ascribed to the polymorphonuclear cells, but latterly, under Aschoff's guidance, much work has been done to emphasize the importance of the so-called reticulo-endothelial system—the system of mononuclear phagocytic cells, fixed and mobile, which Metschnikoff called the macrophages. I have attempted to appraise the significance of each of these factors in my experiments on the clearing mechanism. By injections of a vital dye, to blockade the reticulo-endothelial system, and in another set of animals, by injections of benzole to eliminate the polymorphonuclear cells, I have failed to produce any serious effect on the rate or the completeness of the removal of bacteria from the blood stream. From this and from other evidence it seems necessary to conclude that the mechanism is a complex one, and that the body has several cellular elements upon which to rely for this purpose, and that all of these have need of the assistance of serum opsonins.

We have seen that in a pneumococcal infection, an example of an infection unassociated, so far as we know, with intoxication, there is good evidence for supposing that resistance, in the long run, is dependent upon opsonization. But mere phagocytosis does not necessarily mean death of the phagocyted bacteria. Usually it does, but we have still much to learn of the factors concerned and the influence of immunization thereon. Destruction of organisms is largely conditioned by the possession of antibodies, but it has been shown that there is a still more fundamental factor than the possession of antibodies, namely, the capacity to produce them. Hitherto I have omitted all consideration of the antitoxic factor in immunity, not because it is unimportant, but because the basis of this is so well known and recent work has chiefly served to confirm and extend the older results. Neither in this nor in antibacterial immunity have we any certain evidence of the existence of a purely cellular immunity resulting from immunization. True, certain animal species owe their natural insusceptibility to the action of certain toxins to some cellular peculiarity of the nervous system, but I know of no evidence of the artificial enhancement of the natural condition. But Glenny has shown for diphtheria toxin, as Brooks and Rowland did long ago for the opsonins for *Bacillus pestis*, that an animal, once injected with bacteria or their products, reacts thereafter both more quickly and more effectively to subsequent injections of the same or related antigens. On a second injection being given, more antitoxin is produced, and it is produced in a shorter time. This so-called "secondary response" indicates that the whole mechanism of antibody production has been improved by experience. Some children, rendered "Schick negative" by artificial immunization, may later become "Schick positive" again, but their basal immunity is so altered by the immunization that the mere injection of the small amount of toxin used in the Schick test is enough to stimulate antitoxin production and restore the failure to react once more. It is clear that immunity in the real absence of antibodies at the time of inoculation may depend on the capacity to produce them rapidly. The phenomenon of allergy, in its grossest expression, is an almost entirely harmful process, a reaction between cells and antigen which results in tissue destruction. But the secondary response we have been considering is probably very similar in its essential nature, and its relation to the immunizing processes is obvious. There is a little evidence that the allergic tuberculous animal is better able to produce antibodies to a variety of antigens than is the normal, but this requires confirmation. It is, however, clear from what has been said, that animals may vary much in their immunizability and that this may be altered by artificial immunization.

But bacteria under ordinary conditions do not pass directly into the blood stream. They enter the body through some covering surface, with or without the aid of trauma. It is to the advantage of the animal to be able to limit the ravages of such invaders, both in degree and in extent. And the mechanism we have been considering is well calculated to do this. It has the effect of aggregating the organisms *in situ*, of destroying them in phagocytic cells, and of neutralizing their poisoning products. In such attempts antibodies are, of course, of fundamental importance, but it is also evident that, in most parts of the body the number of cells locally available to help in the process is relatively limited and may require reinforcement. In any given instance, with a definite amount of antibody available and a given dose of bacteria, the outcome will be determined by the number and quality of the cells available. Anything tending to increase these will therefore help in eliminating the infecting agent. And so the whole inflammatory process, with its local vascular changes, exudations and distant effects, becomes an important and integral part of the animal's defence mechanism. Winternitz found that animals treated with benzole to eliminate the circulating leucocytes, when inoculated intratracheally with pneumococci, developed general septicæmia, but untreated animals tended to localize the infection to the lung. On the contrary, Gay has found that accumulation of histiocytes (mononuclear phagocytes) around intrapleural injections of hæmolytic streptococci dealt effectively with these organisms. Ledingham has also stressed the importance of the same type of cells in limiting the progress of vaccinia. Besredka has introduced a new conception into immunology and therapeutics, the idea of antivirus, a substance produced during the growth of an organism in a broth culture, separable by filtration, which, when it gains access to the susceptible cells, protects them against the corresponding bacteria. The recent work of Mallory and Marble and other workers in animals, coupled with that of Broom on the chemical changes occurring in such cultures, goes far to disprove the existence of any real entity corresponding to Besredka's antivirus. It is shown, however, that Besredka's procedure and many others, such as the application of broth, lead to the enhancement of local resistance which is dependent on local non-specific factors, especially the accumulation of mononuclear phagocytic cells. Indeed, we seem by this rather long semi-scientific route to have reached something very near to the old mustard plaster, the linseed poultice and the fly blister. Locally, then, as generally, we find our resistance based upon the antibodies and the phagocytic cells and its effectiveness determined by their capacity to kill the invading organisms, a very slight modification of the original views of Wright and of Metschnikoff.

We have seen that one objection to the classical view that the antibodies play a predominant rôle in immunity, namely, the alleged occurrence of immunity in the absence of antibodies, is based on a misconception. There are, however, other considerations which are bound to raise doubts as to the correctness of this view. The most striking of these is to be found in those cases of bacteriæmia of a chronic type associated with subacute bacterial endocarditis. In this disease we have a condition caused by an organism which is to all intents and purposes avirulent and yet it succeeds in establishing itself in the heart valves and in maintaining itself there and almost invariably in killing its victim. Normally, such organisms, when injected into the blood stream of normal animals, and still more of immune animals, are removed and destroyed practically instantaneously. And yet the human disease is characterized by prolonged and continuous bacteriæmia lasting for months. Moreover, the blood of such patients is usually provided richly with antibodies, often much more so than the sera of immunized horses used for therapeutic purposes. And the high state of the general immunity in the patients is well evidenced by the fact that although circulatory accidents are common, suppuration in such infarcts as may be formed is extremely rare, although the embolus may be heavily infected with organisms from the diseased valve. I am quite unable to accept the view that the organisms in such a patient's blood have been specially modified in some way and are therefore able to grow more readily in the animal body, nor have I been able to find that they are equipped with some special property which, as Rosenow suggests, determines their localization in the valves of an animal into which they may be injected. The bacteriæmia is not due to the multiplication of organisms in the circulating blood, for it can easily be shown *in vitro* that the bacteria in the blood are incapable of multiplying therein, whether it comes from the human case or the experimental animal. Indeed the blood rapidly sterilizes itself. In the course of immunization against pneumococci or streptococci some of the animals will develop endocarditis late in the process, at a time when they may be well supplied with antibodies. And in Wadsworth's experiments on horses it has been found that the organisms present in the blood when the condition has developed, have undergone a degradation to the rough avirulent form. There is a little, but as yet not sufficient, evidence to indicate that trauma of the valve favours localization of the bacteria therein, just as there is evidence that the natural disease in man tends to be commoner in individuals whose valves are the seat of some congenital or acquired abnormality. Everything points to the initiation of the process as being due to a local accident largely conditioned by trauma, and my own view is that the persistence of the infection is also due to the peculiar local conditions in the lesion as a result of which the phagocytic cells cannot gain access to the bacteria; the bacteriæmia is simply an overflow from the infected foci in the lesion. It is apparent how unlikely any process such as active or passive immunization is to clear out such a focus and also how any process at all

which aims at sterilizing the blood stream is simply a form of symptomatic treatment. Apart, then, from the general phenomena of immunity we must also consider two further local factors—those which lead to the establishment of local foci, and those which permit of the maintenance of such foci in spite of the presence of a high degree of general resistance.

The first of these is an old clinical problem, well instanced in the effect of trauma on the establishment of osteomyelitis. A local inflammation may be an expression of resistance, the attempt of the body to prevent the dissemination of an organism which has entered the neighbourhood; but it may also be an indication of a local lowering of resistance. Calmette and Guérin showed that vaccine virus injected into the circulation of rabbits tended to localize itself in areas where the hair had been pulled out, and many other workers have demonstrated the importance of even minimal amounts of injury. Now all trauma has for one of its results the liberation of histamine or some similar substance from the damaged cells, and this increases the permeability of the capillaries and so allows of the escape of the contents of these vessels to a greater extent than normally occurs, and, as Findlay has shown, with the normal blood elements may go any bacteria that happen to be circulating at the time. Apart from merely localizing the bacteria in this way, trauma may provide local conditions for the growth of the organisms, either, as Fildes has shown for tetanus, by producing the necessary anaerobic conditions or by some unexplained means, as in Kettle's experiments on streptococcal infections in mice, in which the organisms were found to multiply readily in areas rendered necrotic by the injection of solutions of calcium chloride. We recognize the importance of the rôle of trauma in the production of tetanus in man and in osteomyelitis, and it seems highly probable that this factor will be found to be of much wider significance as we come to understand more about the beginnings of many other diseases, especially those of the mucous surfaces.

Subacute infective endocarditis is a special example of human disease in which the barrier to healing appears to be a purely physical one. But I am not sure that the lesson we learn from that condition is not of fairly general application. There is a widespread idea, for which there seems to be little or no real evidence, that in septicæmia the organisms are actually multiplying in the blood stream and, accordingly, whenever such a condition is met with, there is a tendency to regard it as a sign of the complete breakdown of the defences of the body, to be combated by some measure directed towards the sterilization of the blood stream. Muir has recently drawn attention to the lack of accurate knowledge of the true nature of this condition. Until quite recently practically nothing was known of the quantitative factor of the blood infection. Our knowledge is still not great, but it becomes clear that there are very few cases in man in which this in any way approaches the degree to be found in the experimental infections of mice and other laboratory animals. The numbers appear to range, as a rule, between one and a few thousand per cubic centimetre of blood, numbers which would probably be readily disposed of if they were all that had to be considered. Moreover, when these numbers increase, they usually increase slowly, and there is a little evidence to indicate that in some cases the number present bears a relation to the extent of the primary focus. I am inclined to think, therefore, that the bacteriæmia which is commonly called septicæmia is no different in essence in pneumonia, puerperal sepsis, typhoid fever or endocarditis, in that it is dependent in the long run on the overflow of organisms from a focus of infection. Such an overflow may be quite harmless, as Barrington and I have shown in the blood invasions which so commonly follow dilatation of the urethra following urethrotomy. The danger lies in the existence which it indicates of uncontrolled foci and the possibility of the establishment of others in other parts of the body. When the condition is successfully treated, it is, I think, because the serum or the drug or natural processes have led, not simply to the sterilization of the blood stream, but to the limitation of the process from which these came, and to the more effective disposal of the emergent organisms, or because the focus has been removed. But this view requires much further confirmation in the form of a more complete study of human septicæmia from all points of view.

We have seen that the focus provides facilities for the growth of an organism in an animal, even if it is possessed of a degree of general resistance. This state of affairs is to be seen in the carriers of diphtheria bacilli and typhoid bacilli as well as in subacute endocarditis. There must be some barrier to the effective access to the focus of the humoral or cellular necessities. In endocarditis it looks as though the barrier were purely anatomical and physical; in pneumonia it may be due to the existence of vascular thrombosis, though the evidence is not convincing; in an acute abscess tension may be enough to prevent effective interchange between the blood and the interior of the focus. We know practically nothing about the question. Hanger has quite recently shown that a rabbit may be immunized against *Bacterium lepisepticum*, a natural pathogen for rabbits, and thereafter an inoculation of living organisms into the skin is without effect. If, however, the immunized animal has also been sensitized to horse serum and a lesion is produced in the skin by the injection of that antigen and then the organisms are introduced into this damaged area, a lesion appears just as in the normal animal. In some way the allergic lesion prevents the effective access of the antibodies which occurs in undamaged areas. How this is done we do not know, but it is evident that it is indeed desirable that we should know more on this topic. It is one of those borderland subjects, the border between morbid anatomy and bacteriology, which tend so much to be left to

the "other fellow" by both parties. It is quite possible that the occasional dramatic results following protein shock therapy are really due to an effect produced upon conditions found in the neighbourhood of the focus.

Apart from the question of possible barriers to the intervention of antibodies, there is another way in which the focus of infection may affect these substances. Cole showed that in a pneumonic lung there were large quantities of material derived from the disintegration of the pneumococci which was able to neutralize the effective antibodies of an antiserum. A given dose of therapeutic serum might in one case remain effective for some considerable time, but in another case it would be found to have been used up almost immediately; and, in order to maintain the antibody content of the blood at an effective level, it would be necessary to repeat the injection of serum at frequent intervals. This point has been again emphasized by Bullowa and his associates. No doubt some of the failures of serum therapy are due to the neglect of this factor.

Time does not permit me to consider other points, such as the complexity of antigenic structure within the bacterial groups, our lack of knowledge of the mechanism available to certain pathogenic organisms, and the limits naturally imposed upon the process of immunization, all of which contribute to the difficulty of effectively applying the facts of immunology to the prevention and cure of disease. It is, of course, possible that the future holds some fundamental discovery which will entirely change our conception of the defence mechanism, but the evidence at present available seems to justify the conclusion that the essential feature of the process is the phagocytosis of bacteria by certain cells aided by the antibodies of the serum. And it is almost equally clear that the effective application of such knowledge as we have meets with very serious difficulties because of our relative ignorance of certain conditions prevailing within the infected focus.

ACUTE ABDOMINAL CONDITIONS.[1]

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When your Secretary invited me to come to Lismore to give you an address, I felt that you had conferred a distinct honour, and I wish to thank you for the compliment.

The subject you have chosen is one dear to my heart. There is nothing in the wide world which can give greater pleasure to the surgeon that the careful examination and treatment of a patient suffering from an acute abdominal crisis, nor, as we know well, is there any condition so fraught with tragic pitfalls and difficulties, nor one in which life may be so dramatically saved by early operation.

The first point which I wish to make is that neither human beings nor their diseases can be standardized. Every patient must be approached with a perfectly open mind and treated upon the merits of his case.

If you are seeing the patient as a consultant, it is far better to know nothing of the other man's opinion. If you respect your colleague's opinion, you may quite unconsciously try to agree with him, and if, on the other hand, you imagine that your *confrère* is not overburdened with clinical acumen, you are apt to disagree before the patient has even been examined.

I have found that so long as you are honest in your attempts at diagnosis, it is wise to act upon first impressions, provided they are not formed by a mere "spot diagnosis".

Every surgeon should himself take a detailed history of the patient. Leading questions should be avoided. In this regard I call to mind a patient who was so bored by multiple examinations that when I started by asking him the routine question: "What do you complain of?" the poor fellow, who was very ill, replied with a sigh: "Have I got to tell you all about it, too?" My reply was that, as I had the responsibility of advising him, I needs must ask some questions. We then became friends, and an adequate history was given. This business of making friends is very important, especially with children, but no less with adults, although the reason is not so apparent. Always bear every whim of the patient with tolerance, for, after all, he is the principal actor in the scene and the surgeon plays but a minor part.

Much has been written and said about the "acute abdomen". With this term we rather colloquially dub a condition of urgent abdominal crisis. It is customary for surgeons to stress the importance of early diagnosis. With this I have no quarrel, but I fear that in some quarters a word of warning is needed. When we have the responsibility of people's lives in our hands, it behoves us to take care that we have logical grounds for adding surgical trauma to a diseased body. Any fool can say "operate", and any fool can operate, but is it for the good of the patient?

In an old household book I remember reading a recipe for jugged hare. This commenced: "First catch your hare", and so I may say, first catch your "acute abdomen". This comparison is to impress upon you the truth of the saying that things are not always what they seem. Occasionally a patient suffering from pneumonia has had to contend with a zealous surgeon as well as the toxins of his disease, and many a child suffering from worms has lost his vermiform appendix, when the exhibition of a worm powder would have been a simpler and more efficient form of treatment.

In the course of my remarks I hope to refer to some of my mistakes, knowing that you will be

[1] Read at the annual meeting of the North-Eastern Medical Association on April 11, 1931.

tolerant. In reference to mistakes, I always make it a rule when a patient dies, if possible, to be present at the *post mortem* examination. There is no better lesson than a well performed *post mortem* examination, nor is there anything more calculated to take the conceit out of us.

The Investigation of the Patient's Condition.

Now we come to the investigation of the patient. In descending order of importance, the following lines of inquiry should be followed.

1. A careful history of the present illness and past health of the patient should be taken.

2. A quizzical assessment and examination of the individual as a whole, including urinalysis, should be made.

3. An examination of the abdomen, going through the whole gamut you were taught as students, commencing with inspection, going on to palpation and so forth. Auscultation should be practised far oftener than is the custom. Rectal examination should always be remembered.

4. Any pathological tests indicated should be made and considered only as an adjuvant to the preceding clinical examination.

To illustrate the importance of the first and second steps of investigation, let me tell you of an error of my own.

One evening some years ago, at the Royal Prince Alfred Hospital, I operated on a young woman with frank signs and symptoms of acute appendicitis. At operation a gangrenous appendix was removed. Next day I happened to meet casually in the street the medical practitioner who had sent her to hospital. I informed him that his patient had had severe appendicitis, and he replied: "Oh, yes, but remember that girl has diabetes." This was news to me. It was not very long before the house surgeon telephoned me to let me know that the girl was becoming drowsy. I had warned him of the doctor's report. The house surgeon was instructed to hustle round and give insulin. This was done, with immediate benefit, and the patient recovered.

Now this girl owed her life entirely to the act of Providence which arranged a chance meeting in the street.

As the antithesis of this case I can tell you of a patient operated on in spite of the contraindication of an unfavourable urinalysis.

A woman who had been subjected to a previous abdominal section, was attacked by pain and vomiting. There was clinical evidence of obstruction of the small bowel. The urine was almost solid with albumin. I asked for consultation with a physician who suggested that the patient should be treated as a uræmic. Next day the patient's condition had improved and the amount of albumin had decreased. The following day vomiting commenced again, and I decided that, uræmia or not, I must open the abdomen. A thick band was found with a lower coil of small gut kinked round it.

The explanation of the sequelæ of events in this case is that the patient was the subject of chronic nephritis. Her bowel had become obstructed, and absorption of toxins from the intestine had caused superimposition of an acute nephritis. Fortunately, the bowel partially undid itself, only to twist again on the third day, when, luckily, I operated.

All patients suffering from obstruction of the small intestine are found to have a high blood urea content, so that a blood urea estimation is not of much use as a means of differentiation between uræmia and intestinal obstruction.

The General Appearance.

The general appearance and behaviour of the patient is one of the most important signs at our disposal. Anyone with fair experience knows that, although it may not be scientific, there is quite a difference between the general appearance of a patient who needs operation and that of a patient who is best treated by conservative means. For example, pneumonia can as a rule be diagnosed early in the course of the disease entirely by the patient's appearance. Typhoid fever has an odour of its own. When I was a senior resident medical officer, a patient was sent in with a diagnosis of "septic abortion for curettement". Whilst examining the woman, I suddenly said to myself, "this woman has typhoid". No operation was done, and the olfactory diagnosis was confirmed by the pathologist. She had aborted because of the typhoid, and curetting would have been bad treatment.

One day a well known physician saw a patient for the first time in hospital. His remark was: "Get the surgeon to see him, the abdomen should be opened." I saw the patient about an hour later. By then all I could make out was that the patient was very ill and possibly had typhoid fever. His clinical picture had changed entirely in the interval. I asked the physician to see the patient again with me, and said that I could not exclude typhoid fever. Whereupon my colleague laughed me to scorn, saying that this was the one thing the patient did not have. We agreed that it would be wise to wait. Next day it was quite obvious that the patient was dying of general peritonitis. *Post mortem* a perforated typhoid ulcer was found. Now, if my friend had only replied, "if he has typhoid, perforation has occurred", it is quite possible that operation would have been done in time.

I must emphasize the clinical fact that a good observer who sees a patient soon after the perforation of a typhoid ulcer, is by far the best judge of the question. An hour or two later it may be quite impossible to tell until it is too late to do any good.

As you all know, patients who are suffering from severe hæmorrhage, have a distinctive appearance. Dr. Foreman used to draw such a graphic picture of ruptured ectopic gestation that when I first became a resident medical officer and had all the enthusiasm of youth, I spotted a patient suffering from this condition when she was being carried through the front hall of the Royal Prince Alfred Hospital. She was pale and obviously distressed, and I thought that if we had been told aright she must have an ectopic gestation which had ruptured; what is more, she had.

The Examination of the Abdomen.

It should not be necessary to remind you that no detail of a routine examination should be missed.

In palpating, never ask the patient whether it hurts. Place the whole flat of your warm hand on the abdominal wall, very gently to start with, and gain the confidence of the patient, talking to him meanwhile about some topic in which he should be interested. By watching his face you can tell at once when there is genuine tenderness. True rigidity can be distinguished from assumed tenseness by the fact that the latter, at the end of expiration, becomes less, while in true rigidity the muscles never relax.

Pathological Tests.

Pathological tests are to be taken for what they are worth, and only as secondary to your clinical opinion. In difficult cases the help of an experienced pathologist is very useful. But he must be capable of giving a quick and accurate opinion. I have seen a patient with an abdomen full of pneumococcal pus whose leucocytes numbered 4,000 per cubic millimetre, and yet as a rule a leucocytosis would be important evidence in such a condition.

To remind me of the possible fallacy of the leucocyte count, only last Tuesday a patient on whom I had performed a double radical cure of inguinal hernia and who had on the tenth day of convalescence developed signs of cholecystitis, had only 6,000 leucocytes per cubic millimetre of blood. The signs, however, were so unequivocal that operation was performed. The gall-bladder was in such an advanced stage of inflammation that it burst when the first sponge was being inserted into the peritoneal cavity.

While on the pathology question, let me remind you that people who have been inoculated against typhoid fever, sometimes get pain and tenderness in the right iliac fossa, accompanied by a rise in temperature, in fact, a clinical picture suggestive of appendicitis. I suppose that the lymphoid tissue of the bowel becomes swollen. I have seen such cases and refrained from interference. Of course, the fact that they got better does not exclude an appendicitis. The condition is rare.

Classification.

We may divide urgent surgical conditions of the abdomen into the following: (i) Those due to trauma, (ii) inflammations, (iii) perforations, (iv) obstructions, (v) torsions.

Symptoms and Signs.

Before proceeding to describe briefly the abnormal conditions referred to under the above headings, it would be well to discuss the symptoms and signs. As you know, the abdominal wall is supplied by the lower seven thoracic nerves, the ilio-hypogastric and ilio-inguinal. Pain is by far the most important symptom to consider, and fortunately it usually is an early manifestation, but has always to be assessed in conjunction with the general temperament of the patient. All pain in an abdominal viscus is due to tension. The hollow viscera are not sensitive to ordinary painful stimuli; but let the tension become abnormally raised, either by great increase of the pressure from within, or by over-contraction of the organ, then the patient is at once aware of an unusual and unpleasant sensation. This pain is conveyed by way of the sympathetic to the cord, and thence to the peripheral distribution of the spinal nerves of the same segment of the cord.

The work of Sir James Mackenzie on peripheral projection of pain is excellent. In two admirable lectures delivered by Burgess, of Manchester, and published in *The British Medical Journal* on December 11, 1920, you will find the best description and explanation of the symptoms of abdominal crises. Burgess there states what I have found to be true:

Pain from the stomach is referred to peripheral distribution of the fifth to eighth dorsal nerves, that is, between the xiphoid cartilage and umbilicus, that from duodenum close above the umbilicus, that from small intestine and appendix (eighth to eleventh dorsal) to the umbilical area (the umbilicus corresponding to tenth dorsal), and that from the large intestine to the mid-hypogastric line. From the liver, gall-bladder and bile ducts (seventh to ninth dorsal) pain is referred to the lower part of the epigastrium and also sometimes to lower angle of the scapula (eighth dorsal).

It is usual for the referred pain—for such is the initial pain—to be felt in or near the middle line; but it is fairly often felt in other parts of the distribution of the nerves concerned, and sometimes on both sides of the body.

Hyperalgesia of the skin areas supplied by the appropriate nerves has been described as an important sign, and theoretically this is correct; but I have not found the sign to be of much practical value.

The later pain is due to irritation of the actual extraperitoneal nerve endings, and is felt at the site of the trouble. This localizing discomfort may be felt early if the offending organ be in close proximity to the parietal peritoneum, or very late indeed if the situation be remote, for example, when the appendix is tucked away among coils of small intestine.

Accompanying the initial pain reflex, vomiting or at least a feeling of nausea is experienced, although it is sometimes not mentioned by the patient. With the advent of the second local pain the motor reflex comes into play and is manifested by a guarding of the muscles overlying the trouble. The rigidity is sometimes quite local, but more often widespread, and is one of the most important signs. With this rigidity there is local tenderness. Genuine tenderness apart from rigidity is an important sign. As you all know, these signs may be entirely masked by the exhibition of morphine. This drug should, if possible, never be given until the responsible surgeon has seen the patient and made up his mind on the question of operation.

With the onset of acute inflammation, Nature provides a beautiful reflex mechanism whereby the peristaltic movement of the intestinal canal is inhibited. The patient should not be robbed of this protection by the injudicious use of purgatives and enemata. The danger of the former appears to be sufficiently appreciated, but not so the latter. To impress the possible dangers of enemata upon your

minds, let me tell of an unfortunate experience of my own.

Some years ago a young man was admitted to hospital early in the morning complaining of the abrupt onset of acute abdominal pain. He was rolling all over the bed and could not be persuaded to keep still. There were no localizing signs whatever. I ordered an enema, as we had been taught to do in such cases. The administration of the first enema met with no result, so the resident medical officer ordered another, with the same failure. Not to be outdone, he instructed the giving of a third enema. Later in the day I saw the patient again. It was then evident that he had general peritonitis. I mopped the contents of all three enemata from the peritoneal cavity, a situation the fluid had reached by way of a perforation of the appendix. The patient died, and I learned a good lesson: Never give an enema to a patient who may have acute appendicitis. There is an exception to prove every rule. This patient was the variation of the almost constant rule that patients suffering from appendicitis, or any other abdominal inflammation, lie quietly in bed. The persistent vomiting due to paresis of the bowel from inflammation or to mechanical obstruction should not be awaited.

Elevation of the temperature to a degree appropriate to each condition is a helpful confirmatory sign, but normal temperature does not exclude the possibility of serious trouble, and must be disregarded in the presence of more important definite signs. The same rule is applicable to the pulse.

Only last Monday a military officer was sent to hospital from Liverpool Camp with a very definite history of appendicitis. He had a soft abdomen, with slight tenderness low down in the right iliac fossa. There was absolutely no elevation of temperature or pulse rate, yet at operation I found an acutely inflamed appendix. When the appendix was opened subsequently it was found that a considerable part of the mucous membrane was quite gangrenous.

A disproportionate increase in the respiration rate raises a suspicion that we are dealing with a thoracic disease.

Trauma.

Non-Perforating Injuries.

In non-perforating injuries immediate shock is always considerable, even in the well known punch upon the solar plexus. When the violence has been severe, as in accidents in which the patient has been run over, other injuries are frequent accompaniments, and the patient's general condition prohibits any surgical intervention. The difficulty arises when the surgeon is confronted with a patient who has received fairly severe violence to the abdomen and is not in so desperate a general condition. It is wise always to wait, say, for an hour or two, till the immediate shock has passed off. Usually, if a serious abdominal injury be present, there are signs to guide us. Nevertheless, it is sometimes quite impossible to tell whether we are dealing with a severe contusion of the parietes or an intra-abdominal lesion. It is then our duty to take the friends into our confidence and tell them that it might be safer to explore the abdomen. It is not justifiable to operate for rupture of a solid viscus, as a rule. Exceptions there may be; the difficulty is to know exactly what lesion is present.

Early last year I saw a strong young woman within an hour after she had been run over by a heavy motor car. Both the girl and her friend were sure that the wheel had gone over her abdomen. The mark of the wheel was quite distinct obliquely across the upper part of the abdominal wall. Pallor and shock were very evident. Rigidity was not quite constant. Most of the resident medical staff were confident that rupture of a hollow viscus had occurred. I could not agree, and decided to see her again in an hour's time. By then I thought that the liver dulness had decreased, and against my better judgement decided to investigate.

I found copious free blood in the peritoneal cavity and hastily inspected the distal part of the stomach and duodenum. There was no evidence of intestinal contents nor of gas. I sewed up the abdomen at once and the patient made a straightforward recovery.

In comparison with this, a lad who had been bumped against a post which struck the left hypochondrium, was seen forty-eight hours after the accident. He had had continuous pain, and by then had considerable abdominal rigidity, with local tenderness in the right iliac fossa. The general condition was quite good. I wondered whether the accident had only been "put in to make it hard" for me, in a case of appendicitis, and thought it would be wise to wait. I was persuaded to inspect the appendix, agreeing that it might be dangerous if the case were one of severe appendicitis. When I opened the abdomen by a muscle splitting incision free blood at once came from the wound. To everyone's surprise I immediately closed the incision, remarking that I had been fool enough.

So far as I can tell, both these patients suffered from rupture of the spleen, but I do not know. At all events, they both recovered, and it is sometimes unwise to be too curious about the source of intra-abdominal hæmorrhage. Yet another case of bleeding comes to my mind.

A soldier who had been shot through the abdomen was operated on by me some hours afterwards. The abdominal cavity was full of blood, which was mopped up. Blood welled up to fill the peritoneal cavity again. By this time I had found a retroperitoneal hæmatoma over the right common iliac vein; but the patient was nearly dead. I put a couple of stitches in the abdominal incision, intending to send him back to bed, but realizing suddenly that I might be wrong, sewed the wound up more carefully. This man had no treatment except the administration of morphine. Years afterwards, he walked into my rooms quite well, having been a dock labourer at Cockatoo Island since repatriation.

Perforating Wounds.

In cases of stab or bullet wounds of the abdominal wall, it is your duty to ascertain at once whether perforation of the bowel has taken place. This I have learned.

A fine big farmer from Dorset was shot apparently across the front of his abdominal wall. Every doctor on the station saw him with me about six hours after wounding. He was in perfect condition, with no evidence of shock whatever, and no rigidity. We all agreed that the injury merely involved the parietes, and I did not interfere. Next morning he obviously had peritonitis, and on exploration I found a slit as though made with a knife, 15 centimetres (six inches) long, in the small intestine, opposite the insertion of the mesentery. Of course, the poor fellow died, and I made up my mind that I would not err like that again. Years afterwards, in Redfern, one gentleman stabbed another in the abdomen. I saw the victim at the Royal Prince Alfred Hospital. He was suffering from a trivial looking cut, about six millimetres (a quarter of an inch) long, on the abdominal wall. To the surprise of all concerned, I sent him straight round to the theatre and opened his abdomen in the middle line. While I passed the small intestine through my hands, from the ileo-caecal junction upwards, it seemed that I had done an unnecessary operation, until the top end of the jejunum had been reached, when I found two perforations of the bowel. These were oversewn and the patient recovered.

Inflammation.

Appendicitis.

We now come to the most frequent type of abdominal crisis, namely, inflammation. In a large percentage of cases the offending organ is the vermiform appendix. In fact, if a surgeon has to deal with a male, and can only tell that an acute abdominal condition exists, and is quite unable to particularize, if he says appendicitis, on the law of chance alone, he is likely to be right. In an adequate discussion of the differential diagnosis of appendicitis every other possible condition in the abdomen should be excluded. By far the most important consideration in diagnosis is an accurate history. Luckily, a large majority of cases are quite frank on clinical demonstration, but a small minority are very difficult to judge. The familiar type of patient is a young adult, more often male than female, who is suddenly aware of a severe and unusual pain all over the abdomen with the gravamen about the umbilicus and becomes afflicted with an initial attack of vomiting or nausea. This is followed by localization of pain to the right iliac fossa, with very slight elevation of the temperature and increase in the pulse rate. Local tenderness and rigidity are usual. The tongue is furred, and in toxic cases there is often quite a distinct and characteristic odour of the breath. When once recognition of this particular aroma has been acquired by the surgeon, it is a most reliable sign. I can only describe it as being somewhat like the stench of *Bacillus coli* pus, yet quite distinct from this well known and objectionable stimulant of our olfactory sense. Constipation is the rule. In my experience prodromal symptoms are rare. Shivering is sometimes an early complaint, but is very uncommon. In adults a temperature over 38·35° C. (101° F.) almost excludes appendicitis, although there are exceptions, especially in patients who have a generalized infection. In children the temperature is more variable, but even in their case a high temperature is the exception rather than the rule. The site of local tenderness, of course, depends upon the particular area of contiguous parietal peritoneum, for example, when the appendix is in the pelvis the greatest tenderness is elicited by rectal examination. If the appendix be adherent to the psoas muscle, there is, of course, pain on extension of the thigh. If the organ be lying over the *obturator internus* muscle, the rotation test of Zachary Cope may be positive, although I have not often observed it.

Conditions most likely to be confused with appendicitis are the following:

1. *Gastro-Intestinal Irritation.*—Gastro-intestinal irritation may be of various origin, from an overindulgence in food to gastric influenza. In such cases the onset is more gradual, the pain more intermittent, and diarrhœa the rule.

2. *Cholecystitis.*—The patient is of the fair, fat and forty type as a rule. The onset is often preceded by shivering or considerable malaise, and is typically more gradual. The pain is higher and may be constant, though not so insistent as in appendicitis. The local rigidity and tenderness are more pronounced and the temperature more likely to be high. I once operated on a girl six years old, thinking she had an undescended appendix, and found an acutely inflamed gall-bladder.

3. *Right-Sided Renal Colic and Pyelitis.*—In renal colic the pain is more severe and radiates from the loin down the ureter and into the testis, and yet I have seen a patient with all the classical signs of renal colic due to an inflamed appendix lying athwart the ureter. In pyelitis the onset is more gradual and the temperature is higher; the patient is more often a female. There is frequency of micturition, and the pain is felt mostly in the loin. A microscopical examination of the urine should be done in doubtful cases. Urgent micturition is common enough at the onset of appendicitis, but does not persist.

4. *Salpingitis.*—A history of vaginal infection is notoriously difficult to obtain, and an inspection of the parts will often give information on this score. The pain is lower down, and vaginal examination will generally be sufficient to differentiate.

In the case of females, of course, ectopic gestation must be considered, as also must the rare condition of retained menstrual fluid. I have not seen a case of the latter, but a senior colleague has told me of two disastrous examples, when a diagnosis of appendicitis was made through omission to make a vaginal examination.

5. *Perforation of a Duodenal Ulcer.*—The onset when a duodenal ulcer perforates is more sudden and dramatic, and rigidity is more definite. If the patient is seen late, when the fluid has poured down, the greatest tenderness may be over the appendiceal area. I failed to diagnose the first case of ruptured ulcer that I had to deal with on this account. The general appearance and type of respiration in these cases is very important from a diagnostic point of view.

6. *Typhoid Fever.*—The onset of typhoid fever is more gradual, the temperature higher, and the pulse is relatively slow. These facts, combined with the general symptoms, are usually enough to exclude appendicitis. In doubtful cases a leucocyte count can be a good help. Ambulatory cases with perforation are difficult.

7. *Back-Pressure and Inflammation in the Caecum.*—Back-pressure and inflammation in the caecum may be caused by a growth lower down the colon.

Some years ago I got a message that a surgeon had seen a case of appendicitis and had asked that the patient should be operated on. I rushed up to the hospital, found a man with definite tenderness in the right iliac fossa, and removed the appendix. The patient did very well, but came back in a few weeks with acute obstruction due to a ring cancer of the sigmoid colon. I have actually seen the caecum burst from this back pressure.

8. *Intestinal Obstruction.*—In cases of obstructions due to bands, the onset of pain may be sudden enough, but the vomiting is far more persistent and the pain is of a more colicky type and is intermittent. The physical signs are different, too. When

there is toxic or even mechanical obstruction late in the course of appendicitis, the history is the only thing to go by.

9. *Inflammatory Conditions Near the Appendix.*—Inflammatory conditions in the neighbourhood of the appendix include perinephric abscess and pyonephrosis. I have seen one case in which the pyonephrosis burst into the peritoneal cavity. Diagnosis was made only at operation. The wonderful part of it was that the patient did very well. Last year I showed a patient with osteomyelitis of the ischium. This could easily have been mistaken for a pelvic abscess due to appendicitis; but from the history and rectal examination a correct diagnosis was made.

10. *Malaria.*—I have seen malaria mimic acute cholecystitis, lobar pneumonia and malingering. The example of the latter is interesting.

The patient was a young soldier who came into the receiving station on the eve of a battle. His complaint was of abdominal pain. He was seen by all the ambulance officers and was referred to me. His abdomen was soft, and there was no rise of temperature or pulse rate, and no tenderness. As the consulting surgeon to the forces happened to come in, he was asked to give an opinion. I can see the surgeon now, a most capable officer, gently slapping the lad's abdominal wall, with the remark: "You'll soon be better, laddie, for there's nothing wrong with you." However, we decided to be cautious. Next morning the temperature shot up and the crescents of malignant malaria were found in a blood smear.

Figure I.
The patient suffering from large ventral hernia.

11. I have seen various conditions, from Henoch's purpura to acute gonorrhœa, confused with appendicitis, but these mistakes are rarities.

A patient suffering from Henoch's purpura was operated on by me in error. I thought the case was one of appendicitis and found coils of small intestine whose walls were like thick violet plush. Remarking that I had not seen the condition before, I said that the patient's only chance lay in the rapid closing of the abdomen. This was done, and at the end of the operation one of the residents noticed some purpuric spots on the back of the elbow joints. Although the lad developed chicken pox during convalescence, he made a good recovery.

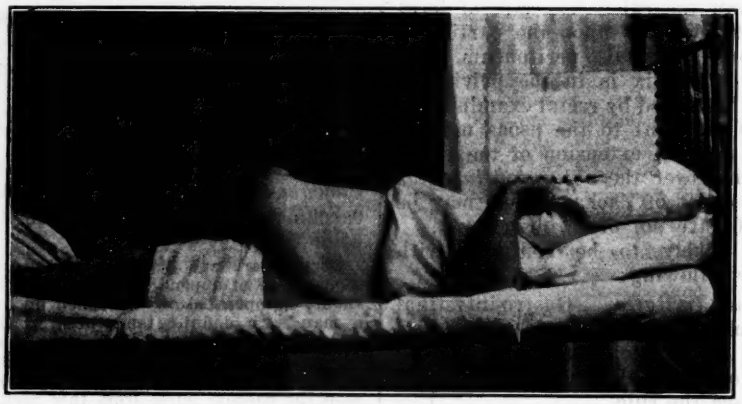

Figure II.
Same patient as Figure I, in recumbent position.

Tetanus may be confused with an "acute abdomen". I was once asked to see a patient whose abdomen was as hard as a board. Instinctively, I felt that the patient was not for operation, but got no further in the diagnosis. In a few hours it was quite obvious that the case was one of tetanus.

Although lead colic must be considered when there has been exposure to lead, it must not be concluded that every painter who complains of abdominal pains is the subject of saturnism.

Some time ago I was urgently called to hospital to see a man who had had abdominal pains for fifteen days and had been treated for lead colic. He had a high temperature and rigid abdomen, with great tenderness of the liver, and was very ill. Remarking that if the patient had been in the tropics I would have made a diagnosis of liver abscess, I opened the abdomen, to find an œdematous umbilical ligament, with signs of widespread liver inflammation. Considering that pyelophlebitis existed, I closed the abdomen. The patient lived another fortnight. *Post mortem* a sloughed appendix was found floating free in the peritoneal cavity, and there were multiple small abscesses in the liver. I should mention that this man was admitted to hospital on the day of his operation.

Diverticulitis may give signs suggestive of appendicitis, but on the left side. The condition does not as a rule require operation. I had one patient to whom the administration of an enema apparently determined the bursting of a diverticular abscess into the peritoneal cavity.

An abdominal crisis of *tabes dorsalis* should always be considered in out of the way cases. Remember that there is no reason why such a patient should not get appendicitis. Curiously, while engaged in compiling these notes, I have come across a most interesting patient.

A female, aged sixty years, the mother of seven children, was seen by me on March 13, 1931. She complained of a swelling of the abdomen which had existed for twenty years, and pain around the umbilicus for six days. The swelling had been the same size for eight years. She had suffered sudden pain, like a "labour pain", round the umbilicus. The pain had persisted, and she had shivered. Her bowels had been open daily. She had vomited twice after the onset of the pain six days previously. She had had milder pain in the swelling ever since, but had not vomited again. The examination revealed a very corpulent lady with a large ventral hernia. The abdomen measured 37·5 centimetres (fifteen inches) across. The swelling extended 50 centimetres (twenty inches) below the xiphisternum and 20 centimetres (eight inches) below the umbilicus. When she stood up, the hernia reached a level five centimetres (two inches) above the patellæ. Lying down, the swelling was 32·5 centimetres (thirteen inches) above the iliac crest, and 77·5 centimetres (thirty-one inches) in circumference. Its shape was that of a truncated cone. The umbilicus was 30 centimetres (twelve inches) below the xiphisternum and 7·5 centimetres (three inches) to the left of the mid-line. Crepitations were present at the bases of both lungs. There was no œdema of the feet. She was sent to hospital at once for observation.

There were many loculi present in the hernial protrusion. The skin varied greatly in thickness; in the upper part it was thinned out like tissue paper, and was thick and œdematous over the lower part, especially over a large loculus well to the left. Here there were also redness and tenderness. The temperature was 38·9° C. (102° F.). The diagnosis was probable incarceration of the omentum, with the possibility of a forming abscess. But for a continued elevation of temperature, the patient remained in excellent condition, and said that she had suffered similar attacks before and had always recovered. She was seen frequently and seemed to be improving, and as operation was undesirable without urgent indication, she was kept at rest till March 20, when the temperature had become 40° C. (104° F.) and the hardness of the lump had been replaced by fluctuation. After consultation some local anæsthetic was injected and a small incision made into the sac. Much pus was evacuated and the patient returned to the ward in good condition. Six or seven hours later she suddenly became blue and collapsed. Next day her blood urea content was estimated at 48 milligrammes per 100 cubic centimetres. Death occurred fifty-one hours after operation. *Post mortem* it was found that the cause of the left-sided abscess was a very long appendix which lay across the abdominal cavity, with a gangrenous tip fixed in the depth of the loculus on the left. There was no general peritonitis at all. The cyanosis was explained by a very large fatty heart with dilatation of the right side. For the notes and photographs I have to thank the House Surgeon, Dr. Meares.

The Treatment of Appendicitis.

Often have I told the students that the man who can tell the condition of the appendix from outside the abdominal wall is a fool or a liar, and this rather bald statement about sums up the position.

If, after a careful history and examination, you reasonably think that appendicitis exists, especially when the patient is seen early in an attack, it is your duty to advise operation. In such a case the risk is mimimal. In abscess cases, it is wise and safe surgery to drain the abscess only, and to leave the appendix till later unless it presents itself. With regard to the late cases with frank evidence of widespread peritonitis, I am not quite sure that our usual custom in this country is right. Ochsner in 1900 insisted that when the trouble had spread, no operation should be done until the patient had been put into a condition to stand it, the treatment in the meantime being to withhold all food by mouth and give rectal feedings. Let me here draw your attention to the advocacy by John Fraser, of Edinburgh, of the use of tap water instead of saline solution as an injection into the rectum. He logically says that water relieves thirst better than salt and, moreover, should be absorbed more readily. Nowadays, in addition, we should give gas gangrene antiserum intramuscularly and glucose intravenously, with insulin intramuscularly to enable the body to make use of the sugar. Of course, if vomiting be persistent, gastric lavage should be practised far more than is usual. Morphine in moderate doses may be given to control peristalsis.

I remember a man who had a very distended abdomen and general peritonitis. I told him that he had appendicitis as far as could be ascertained, and advised operation. The patient's reply was: "If you do that, I shall vomit, choke and die." I said that may be, but I can only give my opinion. Consent was given, and the patient did exactly as he had foretold, just as I was about to make the incision. Luckily the coroner's doctor found a gangrenous appendix with general peritonitis. If this man had been treated by Ochsner's method, he certainly would have had some chance; he had none as it was.

If you look at the statistics of the Royal Prince Alfred Hospital, you will notice that the death rate from general peritonitis is very high—40%. Possibly we have been a little too eager to operate on patients of this type when they are seen late. In all other cases, without any doubt, procrastination is the root of all evil, as also in this type when seen early.

One point I must make, and it is this: If you consider a hundred cases of appendicitis of all types, I honestly think that in more than 90 the patient would recover from that particular attack without operation. This should be no excuse to delay operation when it is perfectly safe, in early and evident cases, but it is a strong indication for us to hold our hands when there must be grave doubt about the diagnosis. Much has been written and said of late about the necessity of early action, and these efforts at improvement are very laudable. But I fear that in this country, though he would be unpopular, it needs someone to point out that not everyone who gets a pain in the belly has appendicitis, and that it is a serious thing to open the abdomen. The conscientious surgeon who takes every care to make a diagnosis, should act on his opinion forthwith. The operating maniac, often deft to a degree, should be suppressed. When it comes to one of our own, we are not keen on operations unless the indication be definite.

With regard to technique, all I shall say is: Be quick without hurrying, make an incision that will give plenty of room, and if there be pus, never sew the wound tightly. No doubt most of you appreciate the value of a suction apparatus. No theatre should be without one. With regard to drainage of the cavity I am conservative and never hesitate to put in a soft rubber tube for forty-eight hours. In some doubtful cases it may be wise to make a vertical incision.

Acute Cholecystitis.

In cases of acute cholecystitis I think that operation, though rarely urgent, is sometimes unduly delayed. Cholecystostomy is far safer than removal of the gall-bladder in the acute cases, and when you fix the tube in the bladder, use a clove hitch rather than a stitch through the tubing. I know of two cases where the stitch had cut the tube and part of it had been left in the gall-bladder.

Acute Pancreatitis.

Acute pancreatitis is rare. I had a patient under my care who became affected with the condition as a result of a kick. He was seen and operated on forty-eight hours after the injury. Diagnosis was not made till the abdomen was open. I put a tube into the pancreas and the patient recovered.

Perforations

Ruptured Ectopic Gestation.

With perforations is included ruptured ectopic gestation, for the majority of cases of intraperitoneal hæmorrhage are due to the perforation of a tubal gestation sac. Let me remind you of the old dictum that "a woman is always pregnant until you have proved the contrary". On one occasion I was asked to operate on a patient who was supposed to have gall-stones, who had had an attack of pain, was tender in the right hypochondrium, and had pain at the tip of the right shoulder. On making an incision I found free blood; I sutured the wound and made a second incision in the mid-line below the umbilicus and removed a ruptured gestation sac. I made the mistake of relying too much on my colleague's diagnosis. The patient recovered and went home to become pregnant again immediately, this time *in utero*, and was delivered at the Women's Hospital by the doctor with whom I had seen her on the first occasion. One night I was rung by a gynæcologist of the staff of the Royal Prince Alfred Hospital, who told me that he was sending a patient suffering from ruptured gastric ulcer to hospital and that I should be called up. My reply was: "No, a colleague is standing by after midnight." The general surgeon went to hospital and removed a ruptured tube with its gestation sac. These two cases remind you that pain in the shoulder is sometimes present when blood flows up on the under-surface of the diaphragm.

Hæmatemesis is here mentioned, to be dismissed, for it does not come within the category of the discussion. Patients suffering from this condition should never be operated on in the acute stage, nor should they ever be given intravenous injections of saline solution. It is very doubtful whether it is wise to transfuse blood when the bleeding point is not controlled. Provided a large vessel, like the posterior duodenal artery, be not eroded, these patients recover if they can only be left alone. To some who are at death's door, transfusion may be justified, but for the rest it seems unwise to run the risk of washing their own blood into the peritoneal cavity.

Ruptured Duodenal Ulcer.

Perforation at the site of a duodenal ulcer occurs almost invariably in males between the ages of twenty and forty-five; yet I have seen it in an old woman. In some cases there is a history of previous indigestion; in others there is none whatever. For some reason it was not seen—never by myself—among soldiers on active service, although they were of the correct age. The onset is abrupt. Nothing irritates the peritoneum like the acid contents, so rigidity is early and very definite. If seen an hour after perforation has occurred, the patient may have entered the "dangerous improvement stage" of Mayo, and the diagnosis can easily be missed. These ulcers almost always perforate within half an hour of the ingestion of food, and in hospital practice that food is often beer. Reflex vomiting rarely occurs. An incision to the right of the mid-line in the epigastrium will almost always give immediate access to the perforation, which should be oversewn with wide mattress sutures of silk. It is not wise to perform gastro-enterostomy. When perforation has occurred some twenty-four hours before observation, and when symptoms are abating, it is wise to wait; but you must pick the right case. I have operated on between six and a dozen patients in whom Nature had sealed off the hole better than any surgeon could.

You will notice that the death rate of the condition is far too high, probably because such patients come to the hospital too late.

Obstruction.

In cases of intestinal obstruction early diagnosis and operation hold out the only hope of improvement. When obstruction is due to strangulated hernia, the diagnosis should be easy and operation done at once. Taxis is always uncertain.

When the obstruction is in the small bowel, the onset with sudden pain and persistent vomiting should always arouse suspicion. Foul vomitus should never be awaited. A point that is not seen in print is that vomitus with an odour of stale fish is almost pathognomonic of obstruction of the small intestine. With practice the method of auscultation of intestinal sounds can be a great help. The distinctive high-pitched piping sounds of fluid rushing to a constriction when the abdomen is gently tapped with the finger, when once recognized, cannot be forgotten. A splashing when the patient is shaken is a helpful sign. In distinguishing between obstruction of the small and large intestine, the history, rate of onset of vomiting, shape of the abdomen, and combined auscultation and flicking of the distended coils all help. Examination *per rectum* should not be neglected.

If you think the patient has an obstruction of the small bowel, open the abdomen by a vertical incision and make straight for the ileo-caecal junction and trace the collapsed bowel to the point of obstruction. If distended coils are in the way, tap them as many times as you like. It is good treatment to empty the bowel of its toxic material.

If the patient has been vomiting continuously, always wash out the stomach prior to operation. The intravenous injection of a 10% solution of glucose and the intramuscular injection of one unit of insulin for every three grammes of glucose is very sound practice, as is the administration of gas gangrene antiserum. Some of you may have seen reported six cases of small gut obstruction which I met within sixteen days early last year.

One of these was a strangulation of an obturator hernia in a woman now seventy years of age. Her symptoms were most interesting; and, more remarkable still, she had a recurrence of the pain almost exactly a year later. This time she sent for her doctor within eighteen hours and was operated on by me again. The obturator hernia had become strangulated a second time. On each occasion the onset was heralded by an unbearable pain down the outer side of the left thigh. On the first occasion I remarked to her doctor that if the pain had been on the inner side, I would have diagnosed strangulated obturator hernia, having seen one previous case. The second time, of course, we diagnosed the condition. The explanation is that the external cutaneous nerve of the thigh comes off the same segments of the cord as the obturator.

In cases of acute obstruction of the large intestine a "blind" right lumbar colostomy is by far the safest procedure. It can be done under a local anæsthetic. Distended large intestine will not bear handling. This was taught me by Sir Alexander MacCormick, and I have yet to see a patient so nigh unto death saved as was one by this operation. I have since done quite a few myself. Although very rarely you may make an error and open the bowel below the obstruction, such a misfortune is most unlikely.

Blockage of the intestine by a gall stone is one of the most treacherous kinds of obstruction. The reason is that as the stone moves a little way down the gut, all the symptoms abate and a feeling of false security is engendered.

One evening some years ago I was asked to see a patient who had been sent in with a diagnosis of intestinal obstruction. When I saw her, vomiting had ceased for some time and she was perfectly comfortable, so I advised observation. Next day she was seen by another surgeon, who also refrained from interference. The following day, when seen by the surgeon under whose care she had been admitted, it was obvious that she had obstruction. Operation was done and a gall-stone was found jammed in the ileum. The result was fatal. Soon afterwards I saw a drunken old woman with symptoms remindful of this patient and was rash enough to diagnose gall-stone obstruction. I found not a gall-stone, but whole sections of an orange greedily eaten without mastication, obstructing the lumen. Later still, I was called to see an old woman, supposed to have obstruction of the large intestine. I was of opinion that the block was in the small bowel, and her symptoms were so like the previous cases that I confidently told the house surgeons that a gall-stone was blocking the gut. They smiled quite broadly, till I had opened the abdomen, incised the bowel and delivered the gall-stone. The patient recovered.

I have dealt with few, if any, acute cases of torsion of an organ with a long pedicle.

The following tables were compiled mostly by myself, but partly by willing assistants from the annual reports and histories at the Royal Prince Alfred Hospital. They include the patients of all surgeons for the five years ending June 30, 1926-1930. The grand totals are all slightly too high (appendicitis being about 120 in excess) because a few patients are annually shown as being still in hospital on the thirtieth day of each June, and are again included in the next year's total. It will be noted that the incidence of appendicitis is nearly three times as great as that of all the other considered conditions put together. The figures of perforated duodenal ulcer are from November, 1925, to November, 1930. It appears that there is room for reduction in the percentage death rates, notably in appendicitis with general peritonitis, perforated duodenal ulcer and intestinal obstruction.

TABLE I.

Record of cases of appendicitis at the Royal Prince Alfred Hospital during a period of five years.

Type of Appendicitis.	Number of Cases.	Number of Deaths.	Death Rate per centum.
Uncomplicated acute ..	1287		
Subacute	772		
Chronic	1218		
Uncomplicated (all types)	3277	8	0·24
With abscess	169	3	1·77
With general peritonitis	70	28	40·00
All cases	3516	39	1·10

TABLE II.

Record of various cases other than appendicitis requiring operation at the Royal Prince Alfred Hospital during a period of five years.

Disease.	Number of Cases.	Number of Deaths.	Death Rate per centum.
Cholecystitis	423	23	5·41
Salpingitis	362	10	2·76
Pyosalpinx	70	1	1·42
Ectopic gestation	119	5	4·20
Strangulated inguinal hernia	57	6	10·52
Strangulated femoral hernia	34	4	10·76
Strangulated umbilical and ventral herniæ	24	4	16·66
All forms of intestinal obstruction other than strangulation of hernia	138	27	19·56
Diseases of the pancreas	34	11	32·35
Totals	1302	111	8·52

Now I have wearied you long enough. I have tried to teach a few lessons gleaned from my own experience, and if I have succeeded in stimulating a desire to search for the rugged truth, then I am happy indeed.

Reports of Cases.

LARGE SOLITARY CYST OF THE KIDNEY.

By CECIL COGHLAN, M.B., Ch.M. (Sydney), F.R.C.S. (England), F.R.C.P.I., D.G.O. (Dublin), F.R.A.C.S.,

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A SOLITARY cyst of the kidney, as distinguished from nephritic cysts and polycystic kidneys, is a comparatively rare condition. In 1924, Harpster, Brown and Delcher[1] reported two cases, and after a careful search through

the medical literature, could find only ninety-three other authentic cases. Since then the condition has attracted considerable attention, and several further papers have been published, the latest being by Alexander B. Hepler,[2] who reported seven cases and collected two hundred and forty-nine cases from the literature. Large solitary cysts of the kidney occur more frequently in females than males in the ratio of two to one, and are nearly always situated at one of the poles. In size they vary from that of a hen's egg to a seven months' pregnant uterus.

The ætiology of this condition is indefinite. The theories advanced to explain it are: (i) Defective development, failure of union between Malpighian corpuscles and the connecting tubules. (ii) Proliferation of embryonic rests. (iii) Retention due to some inflammatory process causing constriction of the canaliculi. (iv) Neoplastic growth.

The cyst arises in the cortical substance of the kidney and, reaching the surface, pushes out the kidney capsule before it. Microscopically the wall is usually formed of connective tissue, and occasionally renal elements may be found in it. An epithelial lining is found in some, but is absent in the majority of cases. This supports the view of the neoplastic origin of the cyst. The cyst content is a serous fluid containing urea.

There is no strict line of demarcation between the cyst wall and the kidney, and it cannot be separated from the kidney substance. The kidney itself, except in the neighbourhood of the cyst, is healthy; near the cyst the kidney substance undergoes degenerative changes.

The condition is usually symptomless until it grows to such a size that pressure occurs.

Diagnosis is usually difficult, but a diagnosis by exclusion may be possible. Urinary examination and functional tests reveal no abnormality. The condition from which solitary cysts of the kidney must be differentiated are ovarian cyst, cysts of the liver, spleen, gall-bladder, pancreas and mesentery and retroperitoneal lipomata.

Prognosis is good unless a large cyst interferes by pressure with neighbouring organs.

The treatment is operative and consists of removal of the cyst, with partial or total nephrectomy.

Case Report.

Mrs. R., aged thirty-four years, consulted me for sterility. She had been married seven years and had never conceived. She was a tall, thin woman, who looked older than her stated age, and had a tired, greyish look. She denied any illness or pain, and her menstrual history was normal.

During the routine abdominal examination I detected a large, oval, cystic tumour, extending from the pelvis into the left hypochondrium. The patient had no knowledge of the presence of this tumour and was certainly surprised when I demonstrated it to her. The tumour could be swung slightly on its upper pole. The lower pole rested on the pelvic brim. The upper pole could not be defined. An area of resonance crossed the tumour.

A vaginal examination disclosed the uterus small and well forward in the mid-line, with the cyst above it. My provisional diagnosis was: (i) large cystic kidney, or (ii) hydatid of the spleen, (iii) parasitic ovarian cyst (that is, one adherent to the upper abdominal parietes), (iv) retroperitoneal lipoma.

Urinary examination revealed no abnormality. The blood count was normal. The Casoni and Wassermann tests both gave no reaction. A plain radiograph of the kidney areas was unsatisfactory, so I did an intravenous pyelography with "Abrodil". This disclosed a perfectly normal pelvis and ureter, and demonstrated also that the function of the kidney was normal. Not being able to differentiate further, I admitted her to hospital with a provisional diagnosis of "parasitic ovarian cyst". The operation was performed under "Avertin" anæsthesia. A left pararectal incision 7·5 centimetres (three inches) long was made, with its centre at the level of the umbilicus. When the abdomen was opened, the cyst was seen to be retroperitoneal. The incision was extended upwards, and the cyst and the left kidney removed transperitoneally. The other kidney, liver, spleen *et cetera* were normal. The kidney bed was drained through a lumbar stab, the peritoneum was sutured and the abdomen closed. Convalescence was afebrile and uninterrupted. Three months after the operation the patient had put on 8·1 kilograms (eighteen pounds) in weight, she had lost her toxic look, looked years younger than when I first saw her, and told me that she no longer felt tired—suggestive evidence that absorption from such a large cyst must produce a toxæmia.

Examination of the cyst showed that it arose from the lower pole of the kidney, which was flattened. The edge of the cyst was in direct contact with the kidney substance. The kidney pelvis was normal. Another interesting point about this case was that a utero-salpingograph showed the uterus to be a small bicornuate one and the tubes very rudimentary.

Figure showing cyst of the kidney

Comment.

Solitary cysts of the kidney are rare and are rarely diagnosed before operation. The case reported shows several interesting points:

1. The patient was unaware of the presence of a tumour, easily the size of a thirty weeks' pregnancy.
2. The tumour was absolutely symptomless.
3. The great improvement in general health and well-being after removal of the cyst and kidney points to a toxic absorption from the cyst, a point I have been unable to find commented on in the literature.
4. The presence of a developmental error in the genital apparatus.

Acknowledgement.

My thanks are due to Dr. L. Utz for the pathological examination of the specimen, and to Dr. E. M. Humphery for the photograph.

References.

[1] Chas. M. Harpster, Thomas A. Brown and Austin Delcher: "Solitary Unilateral Large Serous Cysts of the Kidney, with Report of Two Cases and Review of the Literature", *The Journal of Urology*, Volume XI, February, 1924, page 157.
[2] Alexander B. Hepler: "Solitary Cysts of the Kidney", *Surgery, Gynecology and Obstetrics*, Volume L, April, 1930, page 668.

RUPTURE OF THE JEJUNUM.

By A. J. MOLLISON, M.B., Ch.M. (Sydney),
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THE patient, G.N., a male, aged nineteen years, was admitted to the Canberra Government Hospital on June 3, 1931, at 6.45 p.m., with a history of having ridden a motor cycle which had crashed into the back of a dray at about 6 p.m.

Examination revealed the following injuries:

1. The left cheek was torn for a distance of 2·5 centimetres (one inch) from the angle of the mouth.

2. There was a compound comminuted fracture of the mandible at the level of the first left bicuspid tooth, with a cut 3·75 centimetres (one and a half inches) long into the skin along the lower margin of the mandible.

3. There were comminuted fractures of the left radius and ulna about 7·5 centimetres (three inches) from the wrist.

4. There was some rigidity of the abdominal muscles, slightly more pronounced on the left side. There was dulness to percussion between the rib margin and crest of the ilium and not extending further forward than the outer border of the left *rectus abdominis* muscle. There was no bruising of the abdominal wall.

5. There were some slight superficial abrasions of the thighs, chest, abdomen and head.

Under a general anæsthesia by ether administered by the open method, the fractures of the radius and ulna were reduced, one loose fragment was removed from the mandible, the wound over the mandible and the wound of the cheek were sutured. On his return to the ward the patient's condition was fair, and at 11 p.m. a hypodermic injection of 0·008 gramme of morphine (one-eighth of a grain) was given. In the vomitus ejected after the anæsthetic, stale blood was seen.

On June 4, 1931, at 10.30 a.m., the general condition of the patient was fair and he did not complain of any pain. The abdominal muscles were found to be less rigid than earlier, and the dulness slightly decreased in area. There was no sensation of fluid in the abdomen. At 6.30 p.m. the condition of the patient was the same, except possibly for a slight increase in the area of dulness. At 10 p.m. a small soap and water enema was given and a constipated stool was passed. The patient commenced to become restless, and his pulse increased in rate. At 11 p.m. a hypodermic injection of 0·008 (one-eighth of a grain) of morphine was given. There was no vomiting during the day.

On June 5 the patient became more restless. There were an increased area of dulness in the left flank and rigidity of abdominal muscles. The pulse rate increased and the colour was not so satisfactory. At 4 p.m. the abdomen was opened through a left pararectal incision under a general anæsthesia by ether administered by the open method. A moderate amount of pale blood was found, and after the transverse colon had been turned up, a very small amount of fæces was seen; its track was followed down to a complete tear across the jejunum. The mesentery was not bruised. The tear was excised and an end-to-end anastomosis done. The abdomen was cleared out as much as possible and a stab drain inserted in the left flank. The wound was closed with catgut.

The condition of the patient was giving the anæsthetist, Dr. Clyde Finlay, great trouble, the pulse becoming progressively weaker. The patient returned to the ward, but never rallied. By 9 a.m. he had great air hunger and died at 10.15 a.m. The pulse and temperature record is as shown in the table.

The feature of interest in this case is the lack of symptoms for such a severe abdominal catastrophe. Apart from dulness and slight rigidity, with tenderness to palpation, he had no outstanding symptoms for twenty-eight hours after the accident.

Date.	Time.	Pulse Rate.	Temperature.
June 3	8.30 p.m.	96	36·2° C. (97·2° F.).
	9.00 p.m.	106	
	9.30 p.m.	120	
	10.00 p.m.	116	36·2° C. (97·2° F.).
	10.30 p.m.	108	
	11.00 p.m.	110	
	11.30 p.m.	106	
	12 midnight	106	
June 4	12.30 a.m.	108	
	1.00 a.m.	106	
	2.00 a.m.	100	36·8° C. (98·2° F.)
	2.30 a.m.	98	
	3.00 a.m.	96	
	3.30 a.m.	96	
	4.00 a.m.	96	
	4.30 a.m.	92	
	5.00 a.m.	92	
	5.30 a.m.	92	
	6.00 a.m.	92	37·1° C. (98·8° F.)
	6.30 a.m.	106	
	7.30 a.m.	100	
	8.30 a.m.	88	
	9.00 a.m.	88	
	9.30 a.m.	106	
	10.00 a.m.	104	37·8° C. (100° F.)
	12 noon	104	
	2.00 p.m.	108	37·1° C. (98·8° F.)
	4.00 p.m.	100	
	6.00 p.m.	108	38·3° C. (101° F.)
	8.00 p.m.	104	
	10.00 p.m.	120	36·9° C. (98·4° F.)
	11.00 p.m.	134	
June 5	2.00 p.m.	138	38·9° C. (102° F.)

Reviews.

DERMATOLOGY.

THAT the "Handbook of Skin Diseases", by Dr. Frederick Gardiner, should now reach its third edition proves its popularity.[1] This book of 283 pages is intended for the general practitioner and the medical student, and should be most useful to them, as it deals with the more common skin diseases.

Dr. Gardiner has included 59 excellent illustrations, of which the 13 in colour deserve special mention for their accurate colouring.

One of these coloured plates, that of epidermophytosis, is of special interest on account of the apparent prevalence today of ringworm infection of the hands, and his remarks in connexion with this skin infection are well worth reading.

In the chapter dealing with the treatment of syphilis, the author writes: "Mercury should never be neglected, and is still the most dependable of drugs", a view we have always held, and are pleased to see recorded so emphatically by such an authority in an up-to-date work.

Altogether the handbook is written in an "easy to read" style, and can be thoroughly recommended.

THE DIAGNOSIS OF PULMONARY DISEASE.

MANY books have been written on physical examination of the lower part of the respiratory system. More than any other system perhaps it would appear to give scope to the individual to elaborate the views he has gained by his experience. Not least among the works on the subject is the volume by James Crocket, a second edition of which has recently been published.[2]

This book, embodying the author's lectures to students at the Glasgow University, bears throughout the imprint of the sanatorium superintendent rather than the practising physician, and stress is always laid on signs as they appear in pulmonary tuberculosis. In view of the importance of this disease, however, the slight bias of the author detracts little from the merit of his manual. He proceeds on sound lines, discussing the various phases of physical examination with considerable detail, but always with clarity. Copious illustrations relieve the tendency to tedium and aid the visual memory. Radiology is given due consideration, and chapters on silicosis and bronchography enhance the value of the book. One of the best chapters is that dealing with the examination of the larynx in tuberculosis. In the chapter on "Inspection" its importance is duly emphasised: "Inspection at all times yields more information than any other procedure we can adopt."

[1] "Handbook of Skin Diseases", by F. Gardiner, M.D., B.Sc., F.R.C.S.E., F.R.S.E.; Third Edition; 1931. Edinburgh: E. and S. Livingstone. Crown 8vo., pp. 291, with illustrations. Price: 10s. 6d. net.

[2] "The Physical and Radiological Examination of the Lungs, with Special Reference to Tuberculosis and Silicosis, including a Chapter on Laryngeal Tuberculosis", by James Crocket, M.D., D.P.H., F.R.C.P.E.; Second Edition; 1931. London: H. K. Lewis. Demy 8vo., pp. 306, with 151 illustrations, including 40 plates. Price: 16s. net.

This is somewhat of an over-statement, but worthy of careful thought. The author exaggerates somewhat the value of inspection of the ears, eyes, arms, tongue, and so forth. This section reveals the keen observation of the sanatorium superintendent. But many of the signs are simply evidence of asthenia such as he has noticed among his patients, and could be found in other wasting diseases. It is a point well taken, however, that spasm and atrophy of the muscles of the shoulder girdle are typical of pulmonary disease, and evidence thereof can be found, especially in the neck and shoulders, if careful inspection is made. The chapter tends to become tedious; to observe all these points were superhuman. Modern medicine demands speedier methods than this laborious spade work.

The chapter on "Palpation" again reveals too much detail. Who, for instance, could be expected to remember "seven points related to the phrenic nerve where pain could be elicited on pressure in intrathoracic disease"? We confess to a tendency to be unable to see the wood for the trees.

Percussion is dealt with very thoroughly and completely. The description of pitch, resonance, and quality, is aided by the provision of a good diagram. Is it not more nearly correct, though, to refer to pitch as being "raised" than "increased"?

"Auscultation" receives least praise of all, but most space nevertheless. There is hair-splitting in the description of breath sounds, of which we are offered three types and no less than eleven variations. The auther gives his own classification of adventitious sounds, which inevitably differs to a greater or less degree from that of all other teachers. Despite many attempts at uniformity of classification since the days of Laennec, confusion tends to become worse confounded. Though this increases the students' perplexity, it fortunately does not greatly matter from a diagnostic standpoint. To differentiate between pleural friction and râles, we are allowed the luxury of ten distinguishing features. "Vocal resonance, like vocal fremitus, really seldom requires to be elicited. The facts which it can convey usually have already been acquired." This attempt at simplification must be commended.

While the author cherishes none of the illusions of older writers concerning their ability to diagnose chest disease before evidence is obtained by the X ray examination, he is still conservative. He will not allow the radiologist to say: "These shadows are caused by tuberculosis", he may merely say they "suggest tuberculosis". Considerable space is given to a discussion of apparatus and X ray technique, subjects quite beyond students, and better left, in any event, to radiological text books.

In the chapter on "Radiography of the Diseased Lung" some quite good skiagrams are illustrated. The amount of detailed description of interpretation suggests that the author favours the doctrine of "every clinician his own radiologist"; many would demur to this.

Considering the title of the book, the chapter on silicosis is curious. Ætiology, pathology, the distribution of the disease, and its symptomatology are in turn discussed. Though well done, it is hardly in place. Some good points are made regarding the combination of tuberculosis and silicosis, the author showing himself *au fait* with the latest work on this interesting subject.

Bronchography is given a chapter. Several good bronchograms are shown, in which the correct diagnosis was not made until lipiodol had been injected. With most of this brief chapter we are in agreement, but the statement that "bronchography has been found particularly useful in two conditions, pulmonary tuberculosis and bronchiectasis", is to be condemned, and it would be best deleted from future editions. Suspected pulmonary tuberculosis, save in exceptional instances, is a contra-indication to bronchography.

The chapter on tuberculosis of the larynx, for which "no apology is offered", is well done, the diagrams especially being worthy of note. No one has greater opportunities than a sanatorium superintendent for examination of tuberculous laryngitis, and Dr. Crocket has evidently appreciated this fact. Certain it is that laryngoscopic examination should be in the province of all clinicians interested in diseases of the chest.

The book concludes with a glossary of terms and signs used in the physical examination of the lungs. This occupies no less than thirteen pages, and is remarkable chiefly for the number of gentlemen of all countries who appear to have perpetuated their names in clinical medicine by describing some sign, test, or anatomical area. We counted sixty-seven names altogether, and blush to confess that with the majority of them we were hitherto unacquainted. No comment need be offered on the fact that amid the welter the name of Laennec is conspicuous by its absence.

It can be seen, then, that the book is somewhat of a potpourri of the clinical experiences of a sanatorium superintendent, and as such it should prove of value to the Tuberculosis Officers of the Health Services of Great Britain, and to those engaged in sanatorium practice. Though "primarily intended for students", it must be regarded as somewhat advanced, except for those who contemplate taking up tuberculosis work.

It may be doubted, however, whether the study of physical signs alone merits a book to itself. In our opinion the history given by the patient and the evaluation of his symptoms are factors of equal, if not greater, importance in arriving at a diagnosis, and they should not be divorced from mere physical examination.

Notes on Books, Current Journals and New Appliances.

SURGICAL ESSAYS.

"THE MATAS BIRTHDAY VOLUME"[1] comprises a number of surgical essays written in honour of Rudolph Matas, of New Orleans. The collection of these essays is due to friends and pupils of Professor Matas, who deemed that the publication of this volume would be a fitting expression of the admiration and esteem in which they held him. Eleven hundred copies of the book have been printed, the first four hundred being signed by Dr. Matas.

Many distinguished names are found amongst the contributors to this volume, not only of American surgeons, but British and European as well. Rene Leriche, of Strasburg, France, has written an essay on the experimental and clinical basis for arterectomy in the treatment of localized arterial obliterations. J. C. Bloodgood has contributed a paper entitled: "Halsted Thirty-Six Years Ago." R. C. Coffey has dealt with cancer of the rectum and recto-sigmoid, J. B. Deaver with cancer of the breast, and G. W. Crile with anæsthesia. D. P. D. Wilkie, of Edinburgh, has written on splenectomy, and E. A. Graham on observations on the reaction of bronchial fistulæ to acute infections of the upper respiratory tract.

There are many other essays of varied interest, some in Spanish and some in French, as well as in English. Apart from fulfilling its purpose in paying tribute to Rudolph Matas, this volume has considerable scientific value.

THE AUSTRALIAN MUSEUM MAGAZINE.

THE AUSTRALIAN MUSEUM MAGAZINE for January-March, 1932, contains some interesting articles. J. K. Allen writes on cowries, and W. Boardman on "Our Coastal Sponges". Dr. R. G. Waddy contributes an article on the eye and eyesight. Dr. R. J. Tillyard describes the life of a dragon-fly, and A. Musgrave discusses some Australian ticks. The book is well illustrated. This magazine should be more widely known amongst medical practitioners.

[1] "Matas Birthday Volume: A Collection of Surgical Essays Written in Honor of Rudolph Matas"; 1931. New York: Paul B. Hoeber. Imperial 8vo., pp. 409, with illustrations. Price: $10.00 net.

The Medical Journal of Australia

SATURDAY, APRIL 2, 1932.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

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BESREDKA'S ANTIVIRUS.

For many years Professor Besredka, of the Pasteur Institute, Paris, has been carrying on research in immunity. His views differ widely from those accepted by most immunologists. The publication of the English translation of his book in 1930 was welcomed by all who were interested in the subject, and it was pointed out that if his views were correct, his methods of treatment would have a wide application. Besredka holds that so long as it was believed that the mission of leucocytes was to envelop and to kill bacteria, the idea of bactericidal power had to take the lead in all questions of immunity. Since it is known that cells or toxic products of every kind are met by leucocytes of the same devouring activity, he believes that the bactericidal power can be looked on as only one of the phases of the phagocytic process, corresponding to the insalivation which precedes gastro-intestinal digestion in higher animals. He would therefore "replace the idea of bactericidal power by the notion of digestive power". Professor Besredka carried out extensive experiments with staphylococci and applied his results to the problem of vaccine therapy. He pointed out that the effects obtained by injection of vaccines in many types of infection are attributed to the opsonic power of antibodies elaborated by the patients themselves. "Adding their action to that of the antibodies formed in the organism, the antibodies thus united form a powerful weapon against infection."

Besredka finds in this dogmatic interpretation of vaccine therapy something almost irreconcilable with the known facts. Few pathogenic micro-organisms are such "bad producers" of antibodies as the staphylococci, but there are few recoveries more striking than those obtained with staphylococcal vaccine therapy. Besredka cannot attribute these clinical successes to antibodies which are difficult to discover and often problematical. He attributes them to the vaccination of the organ or of the tissue attacked. Vaccines "have the effect of saturating the affinity which the receptive cells, as yet unaffected, have for the virus"; the vaccines desensitize these cells and thus render them unfit to enter into relation with the virus. He thus regards vaccine therapy as prophylactic treatment of healthy receptive cells. Vaccines have in his opinion no effect on cells already affected—the microbes which have invaded them are overcome by phagocytes. Besredka holds that the mode of entrance of the vaccine is of the utmost importance, in fact of no less importance than the choice of the vaccine itself: "The receptive cells being specific, the route by which we propose to realize the vaccination should be equally specific." His experimental observations lead him to regard the skin as the susceptible organ in such infections as those due to the staphylococcus and anthrax, and the bowel in typhoid fever, paratyphoid fever and dysentery. This is a brief outline of the theoretical considerations on which Besredka bases his antivirus treatment.

His antivirus is obtained by making a broth culture of a microorganism and passing the culture through a filter. When no further microorganisms of the specific type can be grown in the filtrate, "antivirus" is supposed to be present. Besredka gives many histories of cases in which this antivirus has been used, and claims the most surprising successes. He goes so far as to suggest that every surgical action of importance should be preceded and, if need be, followed by an abundant irrigation

with antivirus, and states that this precaution should certainly be taken in the course of operations upon the genito-urinary and gastro-intestinal apparatus. In spite of Besredka's earnest advocacy of his antivirus treatment and in spite of the zeal with which he holds to its theoretical bases, neither the method nor the theory has been widely adopted. Certain investigators in Australia and in Europe have found that results similar to some of those claimed by Besredka have been obtained with pure broth. In regard to the theoretical basis, it is interesting to note that in the *Münchener Medizinische Wochenschrift* of November 6, 1931, Professor Rimpau, of Munich, expresses the opinion that the explanation of the action of antivirus is based on a flight of the imagination (*"Gedankenflug"*). At the same time, in view of Besredka's experiments, Professor Rimpau would not state that the remedy should be regarded altogether as empiric (*"nicht rein empirisch"*). He adds that, although the antivirus is thought to be a specific substance produced in cultures in the course of disintegration of the bacteria, most German authorities regard the process of local immunization as an unspecific increase of cell activity. In support of this view he referred to the results obtained with pure broth.

There can be no doubt whatever that the verdict of an inquiry into Besredka's claims would be "not proven". We should like to see an investigation undertaken in Australia, first of all in regard to the nature of antivirus, and secondly, into the results of treatment with antivirus and broth. In the meantime it is not seemly that patients should be put to the expense (for these things apparently are always expensive) of having a medicament of doubtful value prepared for them.

Current Comment.

HISTAMINE AND COLLATERAL CIRCULATION IN THE EXTREMITIES.

In the issue of January 23, 1932, reference was made in these columns to the use of histamine in revealing pathological changes in the minute blood vessels of diabetics. On a previous occasion (December 5, 1931) the stimulant properties of histamine on the hydrochloric acid secretion of the stomach were discussed, together with its use as a test of apparent anacidity. A further contribution on histamine has been made by G. de Takáts.[1] He points out that when a dilute solution of histamine is injected intradermally, a wheal is produced with a distinct arterial flare, and that this is a simple test for determining the presence or inadequacy of the cutaneous collateral circulation. He holds that with the exclusion of some confusing factors and considered with changes in the pulse and the temperature of the skin, the result of the test indicates the circulatory efficiency in the extremities. In normal persons, if histamine be brought in contact with the minute vessels of the skin, vasodilatation occurs in the capillaries, the smallest arterioles and venules. At the same time a vasoconstrictor effect is exerted on the larger arteries and veins. If a solution of histamine acid phosphate be placed on the skin and punctured into the epidermis by a fine hypodermic needle, a purplish spot surrounds the puncture and is usually covered by a wheal. Round the wheal a red arterial flare appears. T. Lewis concluded that the purplish spot was due to a primary dilatation of the minute vessels, that the wheal was due to local increased permeability of the vessel walls, and that the flare was caused by widespread dilatation of contiguous arterioles due to local nervous reflex. Other cutaneous stimuli may cause a flare, such as a scratch, freezing or burning. If the nerves are cut and time has elapsed for degeneration, these agents do not produce a flare. Lewis assumed a local axone reflex with an afferent (probably sensory) path and an efferent vasomotor path. Reaction still occurs after cervical sympathectomy when sufficient time has elapsed for degeneration. This sensory axone reflex may be a defence mechanism for the skin and conjunctiva, but is not elicited on the surface of the abdominal viscera.

De Takáts summarizes three years' experience of the histamine test. Four groups of subjects were tested: (i) A control group of normal young persons or those in whom no disturbance of arterial circulation was suspected; these showed the limits of individual variations. (ii) Patients with fully developed arterial occlusion. (iii) Patients with early, scarcely recognizable impairment of arterial circulation; these showed the value of the test for early recognition. (iv) Patients with local or general spasm of the cutaneous vessels; these might show absent or delayed reactions in spite of adequate arterial inflow. In Group (i) it was noted that immersion in hot water accentuated and in cold water diminished the reaction. Elevation of the limb diminished the flare and the dependent position increased it. During a chill caused by foreign protein the histamine flare was absent. The response was exaggerated under spinal anæsthesia. In Group (ii) the test was used to determine amputation level. De Takáts states that a negative flare is a warning against amputating too low and that

[1] *Archives of Internal Medicine*, November, 1931.

a positive flare may not insure enough circulation for the healing of the stump. Presumably, by "negative" flare he means an absence of flare—either a flare is or is not present; negative has no meaning here. He adds that the histamine reaction alone is not sufficient. Clinical data (pulse, colour and temperature of the limb) are most important criteria. In Group (iii) the histamine reaction was absent or much delayed at the foot and ankle. As in Group (ii), a fall in skin temperature was closely parallel with changes in the histamine response. Postural colour changes were absent or too slight to be of assistance. The histamine response quickly showed impairment of the peripheral circulation. In Group (iv) vascular spasm may cause severe circulatory disturbance; it may occur in anatomically intact vessels or be superimposed on organic arterial obstruction such as that seen in early Buerger's disease. During spasm of the cutaneous vessels the histamine response may be absent or delayed. In every organic vascular occlusion there is a superadded spasm. A hot bath may cause a flare to appear. For clinical purposes immersion of the limb in water at 40° C. should suffice.

The histamine test is a simple and rapid method for determining the collateral circulation in the extremities. Its result depends on the available blood which can flow into the dilated vessels, on the integrity of the nerve paths connecting the skin with the cutaneous vessels and on the state of contraction of the skin vessels. It does not precisely determine the level of vascular occlusion or diminution of vascular pulse as does the oscillometer. It is a functional test. The reactive hyperæmia could be reproduced with other chemical or mechanical irritants, but the use of a powerful vasodilator seems logical. The histamine test may give information in patients with frank gangrene as to the lowest level for safe amputation. Some cases of diabetic gangrene are not of circulatory origin, but due to infection. The legs of some patients may be saved by histamine demonstration of adequate circulation. The use of histamine may indicate the result of treatment.

Histamine at the present time occupies a prominent place in the medical world. It is derived from histidine, which is a constant cleavage product of the more complex plant and animal proteins. As ergamine it has long been known in ergot, and may be made synthetically. It has a powerful effect on uterine muscle, rapidly causing increase in the frequency of uterine contractions. Its action is more brief than that of ergotoxine, but a combination of the two is specially suitable for *post partum* hæmorrhage. In traumatic shock histamine may be the cause of the acute hypotension which occurs. Histamine and other vasodilators are constantly being produced in the body, and many conditions of the blood pressure may be due to capillary poisoning by histamine or some similar substance. The liver contains both histamine and choline, which are both hypotensors and vasodilators. Given by mouth histamine has only a feeble action. Histamine is a powerful miotic and will contract the pupil after dilatation by atropine: it should not be injected for such purpose. It sometimes has a temporary effect in lowering intraocular tension in glaucoma; the intraocular tension may occasionally rise after its use. Its use is accompanied by severe reaction and pain, and hypopyon ulcer has occurred. "Aminoglaucosan" is a histamine preparation. Since histamine is such a potent substance its dosage must be carefully controlled.

THE PREVENTION OF PERITONITIS.

When it is known that an infection is about to occur in part of the body, it is reasonable to take every possible step to increase the resistance of the patient in the hope that the infecting organisms will be overwhelmed and their toxins neutralized.

Some years ago it was shown by several workers that by introducing living and heat-killed colon bacilli into the peritoneal cavity an immunity to subsequent peritonitis due to the colon bacillus or fæcal contamination could be produced. Bernhard Steinberg has recently carried out a series of experiments in an attempt to determine the shortest time in which active immunity could be conferred on an animal so that it would be able to survive an experimentally produced peritonitis.[1] The experiments were carried out on dogs, and the immunizing agents consisted of a mixture of *Bacillus coli communis*, the streptococcus, *Bacillus pyocyaneus*, enterococcus, *Bacillus mucosus-capsulatus* and *Bacillus welchii*. The organisms were isolated from appendices which were the seat of acute inflammation and were "of a determined marked virulence". Immunity in some of the experiments was produced by heat-killed colon bacilli, and in others by the bacterial mixture. It was found that the colon bacillus used produced a higher degree of immunity than the mixture of organisms. The presence of humoral antibodies to account for the immunity could not be determined. The protection secured is, in Steinberg's opinion, not a true immunity, but a hyperleucocytosis, and animals survive the subsequent infection because phagocytes happen to be present in the locality in which the infection occurs. He suggests that the term hyperleucocytic preimmunity should be applied to the process. Within the last two years the author has immunized seventeen persons by intraperitoneal injections of heat-killed colon bacilli prior to abdominal operations. The operations consisted of resection of the colon, intestinal anastomosis, relief of obstruction associated with old endometriosis and old appendiceal abscess. It was found that the best results were obtained if the immunizing material was given intraperitoneally every day for four successive days, and if operation was performed on the day after the fourth dose was given.

This procedure is in the experimental stage. While its use implies a certain lack of faith in operative technique, it must be admitted that there are certain conditions in which it would be acceptable.

[1] *Archives of Surgery*, February, 1932.

Abstracts from Current Medical Literature.

SURGERY.

Hirschsprung's Disease.

F. W. RANKIN AND J. R. LEARMONTH (*American Journal of Surgery*, February, 1932) outline the present status of treatment in Hirschsprung's disease. Reports by Adson, Royle and Wade led the authors to attack the sympathetic nervous supply in eight cases of congenital Hirschsprung's disease. Acquired conditions closely simulate the true form. The ætiology is still obscure. Probably several factors are involved, one of which is faulty innervation, but the pathological condition in the bowel itself is due to secondary changes. Dilatation and hypertrophy proceed *pari passu*. Cases are reported in which the circumference of the bowel has amounted to 110 centimetres. Both muscle coats of the whole length of colon may be involved. Owing to elongation of the mesentery, volvulus is not uncommon. Typical megacolon may be produced by obstruction due to new growth. Symptoms due to the congenital form appear soon after birth and progress into adult life. A dual innervation of rectum and anus is generally accepted. The inferior mesenteric plexus conveys inhibitory impulses, while the authors maintain that the motor supply is derived from the large cœliac plexuses and the paravertebral ganglia. The fibres travel to the colon along the inferior mesenteric artery, carrying inhibitory impulses to the descending colon. mention is made of the various methods of dividing these nerves. Wade and Royle use an extraperitoneal method and section the mesially directed branches of the lumbar ganglia as well as the main chain below the fourth lumbar ganglia. Adson and Judd resect the second, third and fourth lumbar ganglia on both sides by a transperitoneal route. This operation deprives the lower limbs of their vasomotor control. The authors resect the presacral nerve conveying inhibitory nerves to the rectum and motor nerves to the internal *sphincter ani*; the central end of the nerve is traced upwards on the aorta to the inferior mesenteric artery, where the inhibitory nerves on its walls are then divided. The authors claim that all the sympathetic fibres to the affected colon are severed thus, while the vasomotor nerves to the lower extremities are preserved. Eight cases are epitomized. The patients were subjected to this operation with resulting cures.

Post-Operative Massive Collapse of the Lung.

D. BAND AND I. S. HALL (*The British Journal of Surgery*, January, 1932) have made a clinical and experimental study of post-operative massive collapse of the lung. They report four cases. The patients were aged from thirteen to fifty-five years. Two of them were operated upon for appendicitis, one for chronic peptic ulcer and one for a perforated gastric ulcer. The histories of these patients are given in detail. The authors carried out a series of investigations on dogs. They introduced various substances into the bronchi and subjected the dogs to various operative procedures. They conclude that there are three factors which, acting in combination, may lead to collapse. These factors are: (i) a viscid intrabronchial secretion, (ii) abolition of the cough reflex, (iii) limitation of respiratory movement. In discussing the prevention of the condition, they point out that, where possible, bronchial catarrh and oral sepsis should be corrected prior to operation. The choice of anæsthetic is important. The preoperative use of atropine is valuable, but when atropine is combined with heroin or morphine there is danger of depressing the respiratory centres. The prevention of asphyxia and of accumulations of mucus in the respiratory passages is attended to by the anæsthetist. The anæsthetist also has available carbon dioxide gas to keep the patient's lung bases in a fully aerated state. Dressings must be so secured and the posture of the patient must be such that there is no interference with respiratory movements. The author lays great stress on the use of carbon dioxide in treatment.

Empyema with Bronchial Fistula.

JEROME R. HEAD (*Surgery, Gynecology and Obstetrics*, November, 1931) deals with empyema with bronchial fistula simulating lung abscess and bronchiectasis. The clinical manifestations of empyema with bronchial fistula are so different from those of uncomplicated empyema that, from the diagnostic point of view, the condition deserves separate consideration. While uncomplicated empyema presents itself usually as an obvious pleural disease, empyema with bronchial fistula, because a cough productive of large quantities of sputum is its outstanding symptom, is apt to be confused with diseases of the lungs and bronchi. This is found especially when the empyema is small and encysted, and in these circumstances the physical and Röntgenographic signs are usually atypical. Empyema with bronchial fistula closely simulates lung abscess or bronchiectasis; the acute cases simulate lung abscess, the chronic cases bronchiectasis. Four cases are reported in which the diagnosis was uncertain and difficult. It is important to consider the condition in all patients presenting the symptoms of cough and copious sputum. A careful history and physical examination and Röntgenograms taken in the antero-posterior and lateral upright positions, before and after the injection of iodized oil, are essential to the diagnosis. Diagnostic aspiration should not be performed for fear of infecting the pleura in case a lung abscess is present. The treatment of empyema with bronchial fistula is by drainage following rib resection. Closed drainage and irrigations are contraindicated because of the bronchial opening. In the acute cases the fistula and cavity will usually close spontaneously following drainage. If they do not close, secondary operations are required.

The Meniscus of the Knee Joint.

LEONIDAS A. LANTZOUNIS (*Surgery, Gynecology and Obstetrics*, August, 1931) reports a study of end-results obtained by operation in 142 cases of the derangement of the menisci of the knee joint. Most of the patients were males, and the average age at the time of operation was twenty-eight years, although the limits were eleven and sixty-two years. Both knees were equally susceptible to injury, and several patients had both knees operated upon at various times. In a few instances there was no history of injury, and the severity of injury did not seem to have any bearing on the pathological findings. Whenever there had been an injury, pain was a constant symptom, and in most instances was referred to the side of the joint where the meniscus was injured. In exceptional cases the site of the pain apparently bore no reference to the site of the derangement; tenderness was a more reliable guide. In all but fourteen cases swelling was a constant symptom. Only half of the patients gave any history of locking of the joint. Weakness, instability or "giving way" was a complaint of approximately half the patients. On examination, swelling was present in 59%. Pain and tenderness were present in 85%. Localized pain may best be detected by examination of the knee in the semi-flexed position. Very rarely may the injured meniscus be palpated. In a few cases of the recurrent type some atrophy, chiefly of the *vastus medialis* muscle, was apparent. Sixty patients had some limitation of the angle of flexion. In only a few instances are the radiographic findings of much help. Preliminary oxygen injection into the knee joint was performed for some, but it did not aid the radiographic diagnosis. After reviewing this series, the author concludes that it is often impossible to make a diagnosis until the joint has been opened. In chronic cases a detailed history is of more significance than the physical examination. As it is impossible to determine the exact condition of a joint immediately following any injury, conservative treatment was adopted for all acute cases, excepting when irreducible locking was present. Recurrent symptoms called for early operation. The author states that all workers have so far failed to demonstrate any regenerative power in the cartilage. Since 1923 routine operation has been done through a longitudinal incision after

application of a tourniquet. Even when bilateral exposure is desired, longitudinal incisions are preferred. In some cases only after removal of an apparently healthy meniscus was it found to be pathological. No post-operative splinting is employed. Passive mobilization commences at the end of twenty-four hours, and weight-bearing is allowed on the sixth day. The degree of injury to a meniscus is unrelated to the amount of disability, for a "relaxed" meniscus may be associated with a pronounced reaction. Post-operative hæmarthrosis was of moderate degree in all but seventeen instances. Aspiration is never necessary, and resolution occurs after the application of a firm bandage. No cases of infection occurred in this series. Post-operative physical therapy was continued from two to six weeks after the removal of sutures. The average period of convalescence following operation was thirty-eight days. In recording the end-results, the author states that 85% were classified as excellent, as all the patients returned to their regular occupations. The remaining 15% were only partially relieved, for various reasons, such as superimposed fractures, chronic arthritis *et cetera*. He concludes that an untorn hypermobile meniscus is a definite entity and frequently responsible for symptoms pointing to a deranged joint. The presence of arthritis need not contraindicate operation to relieve symptoms referable to a damaged meniscus. Removal of one or both menisci does not result in an unstable knee joint. The relief of symptoms in uncomplicated traumatic lesions of menisci is uniformly complete following removal of the meniscus.

Cystic Development in the Semilunar Cartilages.

E. S. J. KING (*Surgery, Gynecology and Obstetrics*, November, 1931) states that cystic development in the semilunar cartilages of the knee joint was described in 1904, but only during the last decade has it been appreciated as a not uncommon clinical condition. A considerable number of cases have been reported, either singly or in groups, and now are within the experience of most surgeons. Cysts of the semilunar cartilages occur much more commonly in males than in females, are more commonly associated with the external than with the internal meniscus, and have been found more frequently in the left than in the right knee. The condition may be bilateral. The age of the patient is not related to the onset of the condition, since it may be found in young children or old men. Trauma of a more or less definite character is found in the history of the majority of patients. After the onset of the condition, the cysts rapidly progress until they reach a certain size, when they become stationary. Osteoarthritis in the same joint may be an associated lesion, but apparently is independent. Surgical treatment, consisting of removal of the cysts and the cartilage, results in cure. After removal, the cysts are found in the tissue on the outer aspect of the cartilages. On account of their position, cysts cannot be found clinically in the cartilages, but sometimes spaces may be found in them which communicate with the cysts proper. The cysts, which are multiple, vary from minute spaces just visible to the naked eye to those measuring 1·25 centimetres (half an inch) or more in diameter. Microscopically, the cyst walls are composed of fibrous connective tissue or fibro-cartilage, and are lined with a tissue containing elongate cells, which have been described variously as connective tissue and as endothelium. The changes present are as follows. Certain cells enlarge and secrete mucoid material into the connective tissue between them, some of this material becomes more fluid and cysts form, these gradually enlarge and the cells in the neighbourhood revert to their original spindle form, some lying on the surface, but the majority being embedded in the tissue. Briefly, the tissue, under some stimulus, forms a "joint cavity" which is comparable with a bursa or ganglion. The lining of the walls is the same as the lining of the synovial membrane—a modified connective tissue, not endothelium. The cysts are comparable with ganglia. The various hypotheses of their origin are discussed.

Pancreatic Juice and Gall-Bladder Disease.

JOHN A. WOLFER (*Surgery, Gynecology and Obstetrics*, October, 1931) outlines a series of experiments which he has performed to determine the rôle of the pancreatic juice in the production of gall-bladder disease. His series of experiments have extended over two and a half years, and have been concerned with the introduction of pancreatic juice by various methods into the gall-bladder or bile ducts of dogs. His cases have been divided into five groups, according to the number and site of injections. Some animals survived only a few hours, whilst others were alive 186 days later. In all cases an inflammatory reaction was produced, which varied from a condition resembling acute necrosis to a chronic cholecystitis. After the introduction of pancreatic juice by one of the several methods employed, the contents were found constantly to contain numerous organisms. A normal gall-bladder was never found following upon a successful introduction of the juice. In a number of dogs degenerative changes predominated. In some, clumpy material resembling a precalculous condition of the human gall-bladder was found. A few showed a transition stage between necrosis and regenerative phenomena. This latter was characterized by hypertrophy of the gall-bladder wall and the thickening of the mucosa, whilst in those which survived for a moderately long period, a shrunken-up, thickened gall-bladder was found. The author quotes the experiments of Dragstedt, who obtained somewhat similar results even after the pancreatic juice had been passed through a Berkefeld filter to remove bacteria. He suggests that the pancreatic juice is activated by bile, possibly by the presence of interokinase. The acute cholecystic condition produced interfered definitely with the motility of the organ and produced a degree of stasis which, the author suggests, formed a basis for chronic cholecystitis. Great divergence of opinion has been expressed by various authors concerning the frequency of cases in the human subject in which there is found a continuous pathway between the pancreatic and biliary apparatus. Some authors maintain that this condition exists in 84% of cases. It is known that during the excessive vomiting of pregnancy reverse duodenal peristalsis occurs, and possibly a spasm of the sphincter of Oddi occurs simultaneously. This theory may explain the common occurrence of gall-bladder disease in a pregnant woman.

Intermittent Gastric Ileus Due to Mechanical Causes.

K. A. MEYER AND H. A. SINGER (*Surgery, Gynecology and Obstetrics*, December, 1931) describe the condition of intermittent gastric ileus due to mechanical causes. The term gastric ileus denotes a clinical syndrome characterized by pain in the upper part of the abdomen, vomiting of gastric contents, more or less distension of the stomach, and obstruction at the pylorus, as determined radiographically. As with ileus of the intestine, the gastric form may be either dynamic or mechanical. Of the two types the mechanical variety is of greater interest to the surgeon. Gastric ileus may be continuous or intermittent. The continuous type is represented by the familiar pyloric stenosis. The intermittent variety is less well understood. The author has had personal experience with four ætiological factors. The most important is the benign pedunculated gastric tumour which acts as a ball-valve by prolapsing into the pyloric ring or which incites vigorous peristalsis leading to intussusception of the stomach into the duodenum. A cauliflower carcinoma with a pedicle located just proximal to the pylorus illustrates the second type of periodic obstruction to the gastric outlet. The third factor discussed is the gastrolith derived from powders used in the Sippy treatment for ulcer. A coexistent pyloric stenosis prevented the passage of the concrement and occasioned intermittent impaction. The fourth and most unique type of cyclic obstruction was due to an anomalous redundant fold of prepyloric mucosa which, acting like an epiglottis, produced a discontinuous occlusion of the pylorus.

British Medical Association News.

MEDICO-POLITICAL.

A MEETING OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION was held at the Medical Society Hall, East Melbourne, on February 3, 1932, DR. B. M. SUTHERLAND, the President, in the chair.

Financial Statements.

DR. C. H. MOLLISON, the Honorary Treasurer, presented the statement of receipts and payments of the Victorian Branch of the British Medical Association and of the Medical Society of Victoria for the period from January 6, 1931, to January 15, 1932.

Both statements were received and adopted; they are published herewith.

BRITISH MEDICAL ASSOCIATION—VICTORIAN BRANCH.

Statement of Receipts and Payments for Period from January 6, 1931, to January 15, 1932.

RECEIPTS.

	£ s. d.	£ s. d.
January 6, 1931—		
To Balance, National Bank of Australasia, Limited		481 8 9
„ Cash in hand		12 0 0
January 15, 1932—		
To Subscriptions—		
Metropolitan Members	3,414 6 0	
Country Members	1,533 10 3	
Junior Members	280 6 0	
		5,228 2 3
„ Typewriting Department		68 12 9
„ Rentals from Hall		32 0 6
„ Sale, Hospital Report Forms *et cetera*		7 14 0
		£5,829 18 3

PAYMENTS.

	£ s. d.	£ s. d.
January 15, 1932—		
By The Medical Society of Victoria		2,579 12 0
„ *The British Medical Journal*		1,592 6 9
„ Rebates to Subdivisions		90 6 9
„ Salaries—		
Library Assistant	189 11 8	
Assistant Typiste	121 17 6	
		311 9 2
„ Clerical Assistance		1 8 6
„ Postages, Duty Stamps *et cetera*		166 12 11
„ Printing		64 2 5
„ Stationery		66 7 3
„ Commission on New Members		1 0 0
„ Commission to Collector		26 15 5
„ Advertising		10 9 3
„ Audit Fee, 1930		5 5 0
„ Telephone		12 17 9
„ Legal Expenses		16 16 0
„ Bank Charges *et cetera*		6 4 0
„ Electric Light and Power		17 12 2
„ Reporter's Expenses		8 0 5
„ Professor Lambie's Lecture		13 11 0
„ Lanternists		5 10 0
„ Sundries		22 14 8
„ Balance, National Bank of Australasia, Limited	794 16 10	
„ Cash in hand	16 0 0	
		810 16 10
		£5,829 18 3

Compared with the books and accounts of the British Medical Association, Victorian Branch, and found to be in accordance therewith.

C. STANTON CROUCH, Secretary.

CRAWFORD H. MOLLISON, Honorary Treasurer.

J. V. M. WOOD & COMPANY, Chartered Accountants (Aust.).

Melbourne, February 2, 1932.

NOMINATIONS AND ELECTIONS.

THE undermentioned have been elected members of the New South Wales Branch of the British Medical Association:

Accola, James Bernard, M.B., B.S., 1929 (Univ. Sydney), 2, Linwood Avenue, Bexley.

Anderson, Edley Hector, M.B., B.S., 1929 (Univ. Sydney), Gloucester.

Callose, Angelo, M.B., B.S., 1929 (Univ. Sydney), 129, Hillcrest Avenue, Gladesville.

Harbison, Bruce Lister, M.B., B.S., 1929 (Univ. Sydney), Dural Street, Hornsby.

Heighway, Freida Ruth, M.B., B.S., 1930 (Univ. Sydney), 7, Ethel Street, Burwood.

Mahon, Thomas Patrick, M.B., B.S., 1928 (Univ. Sydney), Cowra.

Meares, Stanley Devenish, M.B., 1930 (Univ. Sydney), 6, Chandos Street, Ashfield.

Hospitals.

THE ROYAL ALEXANDRA HOSPITAL FOR CHILDREN.

DIABETES MELLITUS IN CHILDREN.

A REPORT has been received of the work of the diabetic clinic at the Royal Alexandra Hospital for Children, Sydney. The report, which is signed by Dr. Edgar H. M. Stephen, Honorary Physician, Dr. Wilfrid Evans, Honorary Assistant Physician, and Dr. F. A. Tidswell, Director of Pathology, is as follows:

This report embodies the findings of our experience during the twelve months ending August, 1931. Nine children have been under treatment in the clinic for the whole twelve months or for a considerable part of that period. In one instance only was there a history of any

MEDICAL SOCIETY OF VICTORIA.

Statement of Receipts and Payments for Period from January 6, 1931, to January 15, 1932.

RECEIPTS.	£	s.	d.
January 15, 1932—			
To Transfer from British Medical Association, Victorian Branch—Subscriptions	2,579	12	0
„ British Medical Agency Company, Limited	400	0	0
„ Medical Agency—Medical Society of Victoria, in liquidation	5	8	0
„ Balance, National Bank of Australasia, Limited	342	9	4
	£3,327	9	4

PAYMENTS.	£	s.	d.	£	s.	d.
January 6, 1931—						
By Balance, National Bank of Australasia, Limited				73	16	5
January 15, 1932—						
By THE MEDICAL JOURNAL OF AUSTRALIA				1,525	0	0
„ Interest on Building Fund Debentures				421	15	0
„ Salaries—						
Secretary	825	0	0			
Library Clerk	72	0	0			
Caretaker	100	0	0			
				997	0	0
„ Library, Journals and Binding				151	13	10
„ Furniture				19	16	2
„ Rates, Taxes and Insurance				58	1	5
„ Light and Power				17	12	1
„ Audit Fees				5	5	0
„ Telephone				12	17	11
„ Entertaining Guests				8	6	6
„ Bank Charges				1	10	0
„ Repairs				20	16	9
„ Sundries				13	18	3
				£3,327	9	4

Compared with the books and accounts of the Medical Society of Victoria and found to be in accordance therewith.

C. STANTON CROUCH, Secretary.
CRAWFORD H. MOLLISON, Honorary Treasurer.

J. V. M. WOOD & COMPANY,
Chartered Accountants (Aust.).

Melbourne,
February 2, 1932.

illness shortly preceding the detection of glycosuria. The symptoms noted were loss of weight and strength, thirst, polyuria and in some cases increased appetite.

Two of the patients were admitted in coma. Four have exhibited coma during the course of their illness.

Some clinics report that it is their practice to maintain the carbohydrate element of the diet at a proportion similar to that of a child in normal health. This may necessitate the use of large quantities of insulin, given in many cases more than twice a day. The amount of carbohydrate allowed in our scheme protected the patients from ketosis and was but one-quarter to one-third of the generous allowance above referred to. In this way the quantity of insulin we used did not exceed seventy units *per diem*, with the exception of one patient, B.S., a girl of ten years, who received over 100 units of insulin *per diem*. She made no satisfactory progress in spite of various modifications in the administration of insulin and frequent adjustments of diet. She died in coma after an unwonted dietetic indiscretion. The pathological findings by the Director of Pathology are of interest and are appended at the conclusion of this report.

All our patients received insulin, though for some part of the year two of them showed no glycosuria, with the assistance of a carefully regulated diet alone.

We came to the conclusion that the most reliable standard for estimating the caloric requirements of children was that of the "expected weight for age".

The following facts were impressed upon us during the course of the year:

1. Any infection, however trivial, necessitated an increase in the amount of insulin administered.

2. Much physical exertion assisted metabolism materially and the quantity of insulin required varies with this factor. The result of excessive exertion was shown by a boy who developed hypoglycæmia as a consequence of a long bicycle ride after receiving his normal allowance of insulin.

3. It may be desirable to mention that a "starvation" or "liquid day", or day of carbohydrate starvation in a patient exhibiting ketonuria is almost certain to precipitate coma.

4. As the child advances towards adolescence, he can tolerate a higher proportion of fat in his diet and thrive on it.

5. The result of treatment was considered satisfactory if there was an absence of symptoms of the disease, freedom from glycosuria and a satisfactory gain in weight.

6. Great variation was observed as regards the effect of insulin in the treatment of coma or the precomatose state. One child, B.P., in a precomatose condition, became free of glycosuria after receiving a total of 90 units of insulin, and apparently stored insulin effectively, as 36 hours elapsed before glycosuria appeared and insulin was resumed. His diet could safely be restored to its normal level in three days. On the other hand, H.W. was in a precomatose condition with definite increase in the size of his liver. He received 195 units of insulin in eighteen hours. By this time he was free of ketonuria, but, though his normal allowance of insulin was administered, he was unable to tolerate a diet of his customary caloric value for eight days.

Without pretence to finality, the biochemical tests performed seemed to furnish the following practical guidance. The ordinary urine tests need to be regularly done: three tests a day were found sufficient for diet and insulin regulation. Occasionally the total sugar passed *per diem* was determined, as a matter of interest rather than one of clinical importance. Blood sugar tests were not made regularly, but only when thought to be indicated. Generally a determination was made when the case first came under observation, to confirm diagnosis and gauge the deficiency. Usually the blood was tested when the urine became free from sugar to explore the question of hypoglycæmia. Occasionally observations were made on the range of blood sugar, the effect of a change of diet, the period of some particular dose of insulin, or

on some other such point which arose in the course of treatment. As we found that a glucose tolerance test might be very disturbing to our patients, we preferred to avoid it as much as possible; it is practically reserved for suspected renal glycosuria.

Calculation of Diabetic Child's Diet.

To calculate the total caloric requirements at different ages the following instructions may be given.

For a child of six years, multiply the child's expected weight in kilograms by 75; for a child of ten years by 70; and for a child of twelve years by 60. The usual caloric requirements for different ages are as follows:

6	years,	total calories ..	1,500
7	years,	total calories ..	1,650
8	years,	total calories ..	1,800
9	years,	total calories ..	1,900
10	years,	total calories ..	2,000
11	years,	total calories ..	2,050
12	years,	total calories ..	2,100

These figures in each case are the maximum.

The amount of protein is calculated by multiplying the child's weight in kilograms by four for a child of six years, three for a child of eight years, and two and a half for a child of twelve years. The amount of carbohydrate allowed for all ages over six years is 80 grammes. Sufficient fat is given to bring the diet to the requisite caloric requirements for the particular age.

Beginning on this standard, diet adjustments are made to suit the individual patient, a somewhat lower proportion of protein and higher proportion of carbohydrate being desirable.

Absence of ketone bodies from the urine, a test for sugar that only occasionally gives a positive result, and a steady gain in weight and height constitute indications that the diet has been satisfactorily balanced. Blood sugar estimations were made at intervals. Once a complete investigation of the patient is made, repeated blood sugar estimations are but rarely necessary.

As regards the average weight and height of Australian children, it was found that they conform to the standard of English text books and that of Holt in the United States of America.

Professor Harvey Sutton kindly supplied us with standards ascertained by investigation of pupils of the State schools of New South Wales, conducted by the medical officers of the Education Department of New South Wales.

The accompanying table shows at a glance the principal points of interest in each case.

Initials, Sex and Weight.	Age at Onset.	Duration of Illness.	Comatose or Precomatose.	Amount of Insulin in Units.	Carbohydrate, Protein, Fat, in Grammes.	Points of Special Interest.
B.M., male, 91½ pounds.	9	36 months		25 a.m. 12½ p.m. 37½ total	55·75, 80·5 169·2 2,067 calories	Hypoglycæmic after excessive exertion.
B.S., female.	9	34 months	Two occasions, the last fatal.	50 a.m. 50 p.m. 100 total	88, 76, 80 1,369 calories	
D.A., female, 71 pounds.	11	18 months	Once, on admission.	7½ a.m. 5 p.m. 12½ total	80, 73, 140 1,876 calories	For some time kept sugar-free without insulin.
L.D., female, 65 pounds.	10	14 months		15 a.m. 10 p.m. 25 total	95, 78, 147 2,015 calories	
H.W., male, 53½ pounds.	9	25 months	Two occasions, July 14, 1931, February 19, 1931.	30 a.m. 20 p.m. 50 total	120, 94·5, 150·5 2,215 calories	On July 14, 1931, precomatose. Liver much enlarged. Tolerated, but slow return to normal caloric diet.
C.N., female, 74 pounds.	10	20 months	One occasion, March, 1930.	10 a.m. 5 p.m. 15 total	88, 78·4, 141·2 1,900 calories	For some time kept sugar-free without insulin.
G.L., female, 41½ pounds.	5½	20 months		30 a.m. 10 midday 20 p.m. 60 total	98, 70·7, 95·3 1,532·5 calories	
F.T., male, 41 pounds.	7	12 months			100, 69, 123 1,783 calories	High renal threshold for sugar.
B.P., male, 48½ pounds.	6	42 months	On several occasions.	25 a.m. 15 p.m. 40 total	85, 78·7, 127·5 1,805 calories	

The following method of treatment for a child in coma or the precomatose state gave satisfactory results:

Obtain blood sugar estimation if possible. Give insulin, 40 units, intravenously if coma is present, intramuscularly if the patient is merely drowsy. In two hours' time, if sugar is present in the urine, give insulin, 20 units, intramuscularly. Three hours later give a further 20 units of insulin and again in another four hours, provided always that sugar is present in the urine. The administration of insulin after this will depend on the condition of the child.

Both bowel and stomach should be washed out soon after admission.

If the child is dehydrated, one pint of normal saline solution should be given intravenously.

If the child is able to swallow, fruit juice should be administered as follows:

8 a.m., 100 cubic centimetres of 10% fruit juice.
10 a.m., 100 cubic centimetres of 20% fruit juice.
12 noon, 100 cubic centimetres of 10% fruit juice.
2 p.m., 100 cubic centimetres of 20% fruit juice.
4 p.m., 100 cubic centimetres of 10% fruit juice.
6 p.m., 100 cubic centimetres of 20% fruit juice.
8 p.m., 100 cubic centimetres of 10% fruit juice.
11 p.m., 100 cubic centimetres of 10% fruit juice.
2 a.m., 100 cubic centimetres of 10% fruit juice.
5 a.m., 100 cubic centimetres of 10% fruit juice.

In addition, water should be administered freely.

This diet contains approximately:

Carbohydrate	130 grammes.
Protein	Nil.
Fat	Nil.
Sugar value	130 grammes.
Total calories	520 grammes.

On the second day the following diet is suggested: routine diet number 2, light milk diet, containing:

Carbohydrate	80 grammes.
Protein	28 grammes.
Fat	18 grammes.
Total calories	594 grammes.

On the third day, routine diet number 3 is used, containing:

Carbohydrate	80 grammes.
Protein	39 grammes.
Fat	30 grammes.
Total calories	750 grammes.

Preoperative Treatment of Diabetic Children.

Give four ounces of orange juice at 4 a.m., insulin (10 units) and glucose (15 grammes) at 7 a.m., the hour for operation being 8 to 9 a.m.

The Pathological Findings in the Case of B.S.

The patient was a slim girl, first admitted to the hospital in April, 1929, and was more or less continuously under treatment for diabetes, mostly as an out-patient, but occasionally in the wards for some immediate reason, such as threatening coma, regulation of treatment *et cetera*. She was at home when she became suddenly drowsy, vomited, and, when brought to the hospital, had marked air-hunger and an acetone breath. The blood sugar was 572 milligrammes per 100 cubic centimetres and urea-nitrogen 22 milligrammes. Treatment reduced the blood sugar to 384 milligrammes by next morning, but it then rose again. The urea nitrogen fell to 15 milligrammes, but the urine was albuminous and showed hyaline casts. She passed into deep coma and died the day following admission. At the autopsy there was found a dilated heart and general congestion of all the organs, but only the pancreas, liver and kidney call for comment. The pancreas was not visibly abnormal, but under the microscope showed considerable acute change. Large areas had their cells swollen, cloudy and of vague outline, in many places almost *débris*. Whole lobules were thus degenerated. Here and there an islet stood out unaffected by this change, but in itself poorly cellular and small, though the vessels were apparently normally abundant and wide. Some of the trabeculæ were broader than is usual, but there was no manifest fibrosis nor scars, except in one patch near the tail of the pancreas, where a fairly large and vascularized area was wholly fibrous. In the areas which had escaped the degenerative process, the ordinary pancreatic tissue was of the normal character, but islets were notably scanty and, when found, of inferior structure, often consisting of only a few loose cells and vessels. The blood supply generally seemed abundant and free from obstruction. There were no signs of inflammation. The liver was not structurally altered, but there was moderate fatty infiltration. The kidneys shared in the general congestion; the glomerular vessels in particular were full of blood, but there were no cellular or inflammatory changes which could have caused her condition.

It would seem that some acutely toxic process suddenly terminated the activity of much of a pancreas already handicapped by inadequate islets, for, few as they were in the normal parts, they were still fewer in the degenerated areas, most of them having been affected and destroyed. There was nothing to indicate the source or nature of the toxin.

Conclusion.

The clinic was held at the hospital one afternoon in the week, and those in attendance were the Director of Pathology, an honorary physician, an honorary assistant physician and the sister in charge of the diet kitchen, Miss Eisenberg, whose practical cooperation proved invaluable.

Medical Practice.

MEDICAL REGISTRATION IN TASMANIA.

The Secretary of the Medical Council of Tasmania, Dr. W. L. Crowther, has, at the request of the Council, sent the following information for publication.

All medical practitioners who desire to register, must appear in person before the Medical Council at Hobart or a subcommittee at Launceston.

When they have produced their diplomas and satisfactory proof as to their identity they may be registered. This requirement of the *Medical Act* places any medical practitioner who wishes to go to King Island in a very difficult position, as he must, before proceeding there, visit Launceston to register. To a somewhat less degree the same difficulty presents itself to one who undertakes to practise at Queenstown, Zeehan, Strahan, or Flinders Island.

To meet the requirements of medical practitioners so situated, the subcommittee of the Council at Launceston will, when notified, always convene a meeting to suit their convenience. The medical agents on the mainland have been asked to warn all medical practitioners whom they send to Tasmania of these provisions of the *Medical Act*, but in many cases they have failed to do so.

Correspondence.

DIATHERMY OF TONSILS.

Sir: One cannot but be struck by the different tenor of the correspondence columns of *The British Medical Journal* and The Medical Journal of Australia.

In the former journal one is accustomed to meet a grave and earnest discussion as to the difference, say, between measles and cancer; in the latter all too frequently we find an acrimonious exchange of personalities, full of sound and fury.

The bone of contention is soon lost in the dust of battle, and the interest of the reader is distracted from the importance of the subject by the warlike challenges so valiantly uttered by all concerned.

And they are so true to type, these contests. "Once again our champion, in his ancient armour and upon his faithful Rosinante, rattles forth against that formidable windmill, the Tonsil . . . ." For the remainder of the scene one could not do better than read the original Cervantes.

But one sometimes wishes that in the interests of science they might occasionally find some other windmill.

Yours, etc.,

W. W. Lempriere.

Infectious Diseases Hospital,
Fairfield, Victoria,
March 14, 1932.

Obituary.

CHARLES DONALD RUSSELL

We regret to announce the death of Dr. Charles Donald Russell, which occurred on March 2, 1932, at North Melbourne, Victoria.

Books Received.

CRIMINAL ABORTION, by L. A. Parry, M.D., B.S., F.R.C.S.; 1932. London: John Bale, Sons and Danielsson, Limited. Demy 8vo., pp. 203. Price: 10s. 6d. net.

CLINICAL LECTURES ON PSYCHOLOGICAL MEDICINE, by H. Yellowlees, O.B.E., M.D., F.R.F.P.S., F.R.C.P., M.R.C.P., D.P.M.; 1932. London: J. and A. Churchill. Demy 8vo., pp. 316. Price: 12s. 6d. net.

SOME RADIUM CASES AT THE MIDDLESEX HOSPITAL: A PHOTOGRAPHIC RECORD, by A. Cameron Macleod, M.B., B.S., F.R.C.S.; 1931. London: John Murray. Demy 8vo., pp. 162, with 122 plates. Price: 7s. 6d. net.

THE PRACTICAL MEDICINE SERIES: GENERAL SURGERY; Series 1931. Chicago: The Year Book Publishers. Crown 8vo., pp. 804, with illustrations. Price: $3.00 net.

PHYSIOLOGY OF EXERCISE, by F. A. Schmidt, M.D., and W. Kohlrausch, M.D., translated by C. B. Sputh, M.D.; 1931. Philadelphia: F. A. Davis Company. Royal 8vo., pp. 216, with 44 engravings. Price: $2.50 net.

TEXT-BOOK OF SURGICAL PATHOLOGY, by C. F. W. Illingworth, M.D., F.R.C.S. and B. M. Dick, M.B., F.R.C.S.; 1932. London: J. and A. Churchill. Royal 8vo., pp. 685, with 290 illustrations. Price: 36s. net.

Diary for the Month.

Apr. 5.—New South Wales Branch, B.M.A.: Council (Election of Officers and Standing Committees).
Apr. 6.—Victorian Branch, B.M.A.: Branch.
Apr. 7.—South Australian Branch, B.M.A.: Council.
Apr. 8.—Queensland Branch, B.M.A.: Council.
Apr. 12.—New South Wales Branch, B.M.A.: Ethics Committee.
Apr. 14.—New South Wales Branch, B.M.A.: Clinical Meeting.
Apr. 19.—New South Wales Branch B.M.A.: Executive and Finance Committee.
Apr. 22.—Queensland Branch, B.M.A.: Council.
Apr. 26.—New South Wales Branch, B.M.A.: Medical Politics Committee.
Apr. 27.—Victorian Branch, B.M.A.: Council.
Apr. 28.—South Australian Branch, B.M.A.: Branch.
Apr. 28.—New South Wales Branch, B.M.A.: Branch.

Medical Appointments Vacant, etc.

For announcements of medical appointments vacant, assistants, *locum tenentes*, sought, etc., see "Advertiser," page xiv.

The University of Melbourne, Victoria: Acting Lectureship.

Victorian Eye and Ear Hospital, Melbourne, Victoria: Resident Surgeons (3).

Medical Appointments: Important Notice.

Medical practitioners are requested not to apply for any appointment referred to in the following table, without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

BRANCH.	APPOINTMENTS.
New South Wales: Honorary Secretary, 135, Macquarie Street, Sydney.	Australian Natives' Association. Ashfield and District United Friendly Societies' Dispensary. Balmain United Friendly Societies' Dispensary. Friendly Society Lodges at Casino. Leichhardt and Petersham United Friendly Societies' Dispensary. Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney. North Sydney Friendly Societies' Dispensary Limited. People's Prudential Assurance Company Limited. Phœnix Mutual Provident Society.
Victorian: Honorary Secretary, Medical Society Hall, East Melbourne.	All Institutes or Medical Dispensaries. Australian Prudential Association, Proprietary, Limited. Mutual National Provident Club. National Provident Association. Hospital or other appointments outside Victoria.
Queensland: Honorary Secretary, B.M.A. Building, Adelaide Street, Brisbane.	Brisbane Associated Friendly Societies' Medical Institute. Mount Isa Mines. Toowoomba Associated Friendly Societies' Medical Institute. Chillagoe Hospital. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL are advised, in their own interests, to submit a copy of their agreement to the Council before signing.
South Australian: Secretary, 207, North Terrace, Adelaide.	All Lodge Appointments in South Australia. All Contract Practice Appointments in South Australia.
Western Australian: Honorary Secretary, 65, Saint George's Terrace, Perth.	All Contract Practice Appointments in Western Australia.
New Zealand (Wellington Division): Honorary Secretary, Wellington.	Friendly Society Lodges, Wellington, New Zealand.

Editorial Notices.

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